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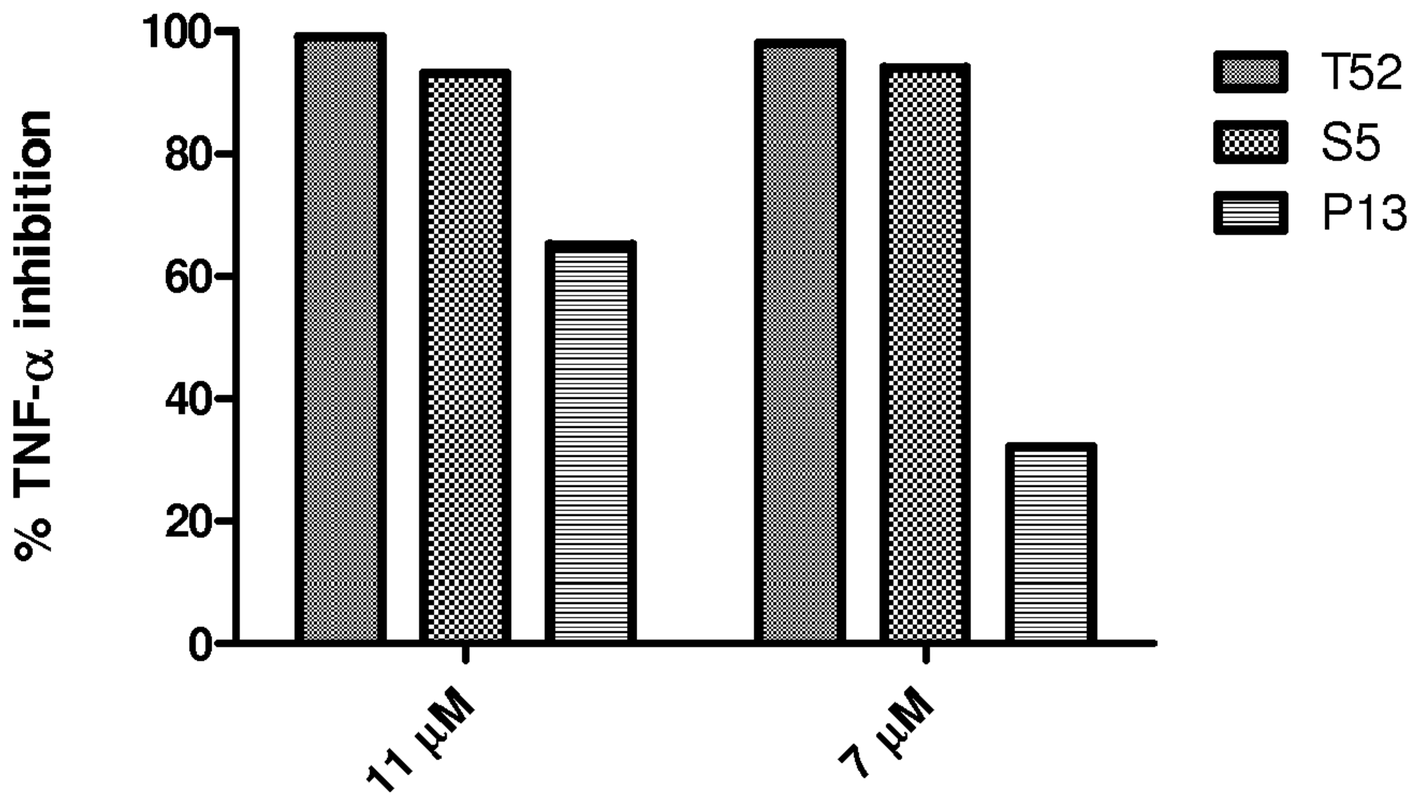


FIGURE 4

(57) Abrégé/Abstract:
Peptides for the treatment of inflammation, and therapeutic uses and methods of using the same are disclosed. Peptides including a transducing sequence are effective for inhibiting cytokine activity and TNF-αsecretion through interaction with toll-like receptors. Experiments are described illustrating the efficacy of the compounds in treating otitis media.

IMMUNOREGULATORY PEPTIDES AND METHODS OF USE

[0001] This application claims priority to U.S. Provisional Application No. 61/184,438, filed June 5, 2009, U.S. Provisional Application No. 61/184,455, filed June 5, 2009, U.S. Provisional Application No. 61/220,738, filed June 26, 2009, U.S. Provisional Application No. 61/220,745, filed June 26, 2009, and U.S. Provisional Application No. 61/256,364, filed October 30, 2009, each of which is incorporated herein by reference in its entirety.

STATEMENT AS TO FEDERALLY SPONSORED RESEARCH

[0002] The work leading to the present invention was supported by SBIR AI065000, "Bacterial-Induced Sepsis: A New Treatment Strategy" and SBIR DC005882, "New Treatment for Inflammation in Middle Ear Infections." The U.S. Government may have certain rights in the invention.

BACKGROUND OF THE INVENTION

[0003] Toll-like receptors (TLRs) recognize and respond to conserved motifs termed pathogen-associated molecular patterns (PAMPs). TLRs are characterized by an extracellular leucine-rich repeat motif and an intracellular Toll/IL-1 receptor (TIR) domain. Triggering of TLRs by PAMPs initiates a series of intracellular signaling events resulting in an inflammatory immune response designed to contain and eliminate the pathogen. Viruses encode immunoregulatory proteins, such as A52R (produced by the vaccina virus), that can effectively inhibit intracellular TIR signaling resulting in a diminished inflammatory immune response.

[0004] Chronic otitis media (COM) affects both children and adults. The chronic inflammation seen in COM can impact the inner ear and can lead to sensorineural hearing loss. COM is a significant medical problem, and no current therapeutics, other than steroids, are available for treating COM. Many patients with COM require surgical placement of ear tubes. As with acute otitis media (AOM), patients with COM experience decreased hearing due to development of an intense inflammatory response within the middle ear, including the presence of residual fluid.

SUMMARY OF THE INVENTION

[0005] In some embodiments, the invention contemplates a pharmaceutical composition comprising a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue.

[0006] In some embodiments, the invention contemplates a pharmaceutical composition comprising a peptide comprising a sequence of any one of SEQ ID NOS: 1-186.

[0007] In some embodiments, the invention contemplates a peptide comprising the sequence of any one of SEQ ID NOS: 1-368.

[0008] In some embodiments, the invention contemplates a derivative of a peptide comprising the sequence of any one of SEQ ID NOS: 1-369, wherein the derivative comprises at least one D-amino acid residue.

[0009] In some embodiments, the invention contemplates a method of regulating cellular activity, the method comprising administering to an organism in need or want thereof an effective amount of a pharmaceutical composition comprising a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0010] In some embodiments, the invention contemplates a method of treating inflammation in an animal, the method comprising administering to an animal in need or want thereof a pharmaceutical composition comprising a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0011] In some embodiments, the invention contemplates a method of treating sinusitis, the method comprising administering an aerosol composition to an organism in need or want thereof, the aerosol composition comprising a therapeutically-effective amount of a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0012] In some embodiments, the invention contemplates a method of improving hearing in an animal, the method comprising administering to an animal having middle and/or inner ear inflammation and reduced hearing a therapeutically-effective amount of a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus, wherein the peptide is administered topically, wherein the hearing improves to a level no better

than ordinary levels, and/or the hearing improves faster than the hearing would improve without administration of the peptide.

[0013] In some embodiments, the invention contemplates a method of treating middle and/or inner ear inflammation, the method comprising administering to a tympanic membrane of an animal in need or want thereof a therapeutically-effective amount of a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0014] In some embodiments, the invention contemplates a use of a peptide in the manufacture of a medicament for regulating cellular activity, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0015] In some embodiments, the invention contemplates a use of a peptide in the manufacture of a medicament for treating inflammation in an animal, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0016] In some embodiments, the invention contemplates a use of a peptide in the manufacture of a medicament for treating sinusitis, the medicament comprising an aerosol composition, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0017] In some embodiments, the invention contemplates a use of a peptide in the manufacture of a medicament for improving hearing in an animal, wherein the animal has middle and/or inner ear inflammation and reduced hearing, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus, wherein the medicament is a topical medicament.

[0018] In some embodiments, the invention contemplates a use of a peptide in the manufacture of a medicament for treating middle and/or inner ear inflammation, wherein the medicament is

suitable for administration to a tympanic membrane of an animal in need or want thereof, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

DESCRIPTION OF THE FIGURES

[0019] FIGURE 1: Illustrates an assay for crossing the tympanic membrane by FITC-labeled P13. Figure 1A. Bright field microscopy demonstrates cells in middle ear fluid. Figure 1B. Fluorescent microscopy demonstrates FITC-labeled P13 associated with cells in middle ear fluid.

[0020] FIGURE 2: P13 reduces middle ear inflammation. BALB/c mice (n=6 in PBS group and n=7 in P13 group) were injected with heat-killed *S. pneumonia*, treated 24 hours later with topical (ear drop) administration of P13 (1 μg), and histology was examined 72 hours after bacteria introduction. Panel A: cell number within middle ear; Panel B: fluid area within middle ear. Note: Animal with high cell number and high fluid area in the P13 treated group is the same animal.

[0021] FIGURE 3: Topical administration of P13 significantly improves hearing thresholds. BALB/c mice were administered heat-killed *S. pneumonia*, 24 hours later mice were treated topically (ear drops) with P13 (1 μg) or PBS. Panel A: Hearing thresholds at 4, 8, 16 and 32 kHz were quantified by ABR at days 5 and 13 days after administration of bacteria. Hearing loss was calculated by subtracting the background ABR from post-treatment ABR and summing across frequencies. Panel B: Number of animals with >20 DB hearing loss across all frequencies. Number of animals is in parentheses.

[0022] FIGURE 4: Percent Inhibition of TNF-α secretion by peptides T52, S5 and P13. RAW264.7 cells were plated at $3X10^5$ cells/well in 48-well plates. After 24 h the cells were incubated with peptide at various concentrations at room temperature in triplicate for 15 minutes and then stimulated with 1 μg/ml CpG-ODN. Cells were then incubated for 4 hours at 37° C, supernatants collected, and TNF-α measured by ELISA. Percent inhibition was calculated by comparing TNF-α secretion from cells incubated with peptide to control cells with no peptide treatment.

INCORPORATION BY REFERENCE

[0023] All publications, patents, and patent applications mentioned in this specification are herein incorporated by reference to the same extent as if each individual publication, patent, or patent application was specifically and individually indicated to be incorporated by reference.

DETAILED DESCRIPTION OF THE INVENTION

[0024] The treatment and control of natural and pathogen-induced inflammation represents a significant clinical challenge. The targeting of the TLR/TIR signaling cascade represents one approach to control inflammation; thus the identification of peptides derived from the A52R protein or A52R-like proteins finds therapeutic applications. The peptides and pharmaceutical compositions of the invention disclosed herein, and uses and methods of using the same, present a solution to the problem of controlling inflammation and regulating cellular pathways associated with inflammation.

[0025] Throughout the disclosure, amino acid residues of the peptides of the invention are referenced by one or both of the standard abbreviations known in the art: a) single-letter abbreviations, such as R for arginine, D for aspartic acid, V for valine, etc.; and b) three-letter abbreviations, such as Arg for arginine, Asp for aspartic acid, Val for valine, etc. The invention contemplates both L- and D-forms of amino acid residues. In cases wherein the abbreviation refers only to an amino acid residue of the D-configuration, the abbreviation is preceded by the term, "D-," for example, D-Arg for D-arginine, D-Asp for D-aspartic acid, D-Val for D-valine, etc.

Toll-like Receptor Signaling

[0026] Toll-Like receptors ("TLRs") are conserved molecular receptors that recognize structures from bacteria, fungi, protozoa, and viruses. Activation of TLRs initiates a series of intracellular events resulting in an innate immune response characterized by the production of pro-inflammatory cytokines (References 2–9). TLR signaling originates from the cytoplasmic Toll/interleukin-1 receptor (TIR) domain, conserved among all TLRs. Not limited by any theory, in certain embodiments, adapter molecule MyD88, containing both a TIR domain and a death domain, can associate with the TIR domain of TLRs and IRAK proteins. Phosporylation of IRAK can then lead to association with TRAF6 and subsequent activation of NF-κB and secretion of pro-inflammatory cytokines (References 14, 22–25).

Peptides

[0027] Vaccinia virus, a member of the poxvirus family, is a DNA virus that has been demonstrated to encode immunomodulatory proteins (References 15–18). One of these proteins, A52R, has been shown to inhibit NF-κB activation following initiation of the TIR signaling cascade (References 15 and 18). Recent studies have demonstrated that A52R inhibits TR signaling and contributes to the virulence of vaccinia virus. In certain embodiments, cell activation in response to different PAMPs involves a number of intracellular molecules common to all TLRs, including but not limited to MyD88, members of the IL-1 receptor-associated kinase (IRAK) proteins, TNF receptor associated factor (TRAF6), and NF-κB (Reference 1).

[0028] Harte and colleagues (Reference 18) have demonstrated that the A52R protein inhibits TIR signaling by binding to both IRAK2 and TRAF6. Deletion of the A52R protein from vaccinia virus results in reduced viral virulence.

[0029] The peptide 13 ("P13") sequence (DIVKLTVYDCI (SEQ ID NO: 369)) was derived from the A52R sequence from vaccinia virus. Blast search analysis shows that peptide P13 has 100% homology with sequences found within larger proteins from vaccinia virus other than A52R, two proteins from cowpox virus, and one protein from rabbit pox virus. Peptide 13 was shown to have significant homology with three separate proteins from different strains of variola (smallpox) virus: i) A46L from variola major virus strain India; ii) A49L from variola minor virus Garcia; and iii) A44L from variola major virus strain.

[0030] P13 inhibits toll-like receptor-dependent signaling (US 7,192,930 and US2008/0039395 incorporated herein by reference in their entirety). In some embodiments, structure-activity testing can be performed to identify amino acid residues in the P13 sequence that can be substituted for enhanced activity.

[0031] In some embodiments, the present invention provides a pharmaceutical composition comprising a peptide derived from A52R. In some embodiments, the pharmaceutical composition is an aural pharmaceutical composition.

[0032] In some embodiments, the peptide is P13. In some embodiments, the peptide is derived from P13. In some embodiments, the peptide is a P13 variant, derivative, stereoisomer, or analogue. In some embodiments, the peptide comprises the amino acid sequence LEEYFMY (SEQ ID NO: 370). In some embodiments, the peptide comprises the amino acid sequence FTILEEYFMY (SEQ ID NO: 371). In some embodiments, the peptide comprises the amino acid sequence DIVKLTVYDCI (SEQ ID NO: 369). In some

embodiments, the peptide comprises the amino acid sequence VYDCI (SEQ ID NO: 372). In some embodiments, the peptide comprises the amino acid sequence VYACI (SEQ ID NO: 373). In some embodiments, the peptide comprises the amino acid sequence KLTVY (SEQ ID NO: 374). In some embodiments, the peptide comprises the amino acid sequence KLYVY (SEQ ID NO: 375). In some embodiments, the peptide comprises the amino acid sequence KVYVY (SEQ ID NO: 376). In some embodiments, the peptide comprises 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, or 50 residues. In some embodiments, the peptide comprises from 7-50 residues.

[0033] In some embodiments, a peptide comprises a transducing sequence. The transducing sequence can participate in cellular uptake. The presence of the transducing sequence can lead to enhanced or selective cellular uptake. In some embodiments, the transducing sequence is at the N-terminus of the peptide. In some embodiments, the transducing sequence is at the C-terminus of the peptide.

[0034] A non-limiting example of a transducing sequence is a poly-arginine sequence. In some embodiments, the poly-arginine sequence comprises arginine residues. In some embodiments, the poly-arginine sequence consists of arginine residues. In specific embodiments, the transducing sequence comprises 3,4,5,6,7,8,9,10,11,12,13,14,15, or 20 arginine residues. In some embodiments, the transducing sequence comprises nine arginine residues. In some embodiments, the transducing sequence consists of nine arginine residues. The arginine residues of the transducing sequence can be L-arginine, D-arginine, or a mixture of L- and D-arginine.

[0035] Table 1 provides non-limiting examples of peptides of the invention. Exemplary peptides 1-130 are those derived from A52R. Of peptides 1-130, a subset is further designated S1-S22. Other examples include peptides derived from P13 ("T peptides"). In some embodiments, the present invention provides a pharmaceutical composition comprising a peptide comprising any amino acid sequence listed in Table 1. In some embodiments, the present invention provides a pharmaceutical composition comprising any peptide listed in Table 1. In some embodiments, the present invention provides a pharmaceutical composition comprising a peptide comprising any amino acid sequence of S1-S22. In some embodiments, the present invention provides a pharmaceutical composition comprising any peptide of S1-S22. In some embodiments, the present invention provides a pharmaceutical composition comprising a peptide comprising any amino acid sequence of T1-T56. In some

embodiments, the present invention provides a pharmaceutical composition comprising any peptide of T1-T56. In some embodiments, the peptide has a transducing sequence. In some embodiments, the transducing sequence is poly-arginine. In some embodiments, the peptide comprises the sequence of any one of SEQ ID NOS: 42-44, 68-77, 79-81, 83, 102-106, 133, 141, 151, 166, 167, 181, 182, 228-230, 254-263, 265-267, 269, 288-292, 319, 327, 337, 352, 353, 367, and 368. In some embodiments, the peptide comprises the sequence of T3, T11, T21, T36, T37, T51, or T52. In some embodiments, the peptide comprises the sequence of T3-R^9, T11-R^9, T21-R^9, T36-R^9, T37-R^9, T51-R^9, or T52-R^9.

Table 1: Exemplary peptides of the invention

Peptide	**Sequence**
1-R^9	YIKVQKQDIVKLTVYDCISMIGLCARRRRRRRRR (SEQ ID NO: 1)
2-R^9	IKVQKQDIVKLTVYDCISMIGLCARRRRRRRRR (SEQ ID NO: 2)
3-R^9	KVQKQDIVKLTVYDCISMIGLCARRRRRRRRR (SEQ ID NO: 3)
4-R^9	VQKQDIVKLTVYDCISMIGLCARRRRRRRRR (SEQ ID NO: 4)
5-R^9	QKQDIVKLTVYDCISMIGLCARRRRRRRRR (SEQ ID NO: 5)
6-R^9	KQDIVKLTVYDCISMIGLCARRRRRRRRR (SEQ ID NO: 6)
7-R^9	QDIVKLTVYDCISMIGLCARRRRRRRRR (SEQ ID NO: 7)
8-R^9	DIVKLTVYDCISMIGLCARRRRRRRRR (SEQ ID NO: 8)
9-R^9	IVKLTVYDCISMIGLCARRRRRRRRR (SEQ ID NO: 9)
10-R^9	VKLTVYDCISMIGLCARRRRRRRRR (SEQ ID NO: 10)
11-R^9	KLTVYDCISMIGLCARRRRRRRRR (SEQ ID NO: 11)
12-R^9	LTVYDCISMIGLCARRRRRRRRR (SEQ ID NO: 12)
13-R^9	TVYDCISMIGLCARRRRRRRRR (SEQ ID NO: 13)
14-R^9	VYDCISMIGLCARRRRRRRRR (SEQ ID NO: 14)
15-R^9	YDCISMIGLCARRRRRRRRR (SEQ ID NO: 15)
16-R^9	DCISMIGLCARRRRRRRRR (SEQ ID NO: 16)
17-R^9	CISMIGLCARRRRRRRRR (SEQ ID NO: 17)
18-R^9	ISMIGLCARRRRRRRRR (SEQ ID NO: 18)
19-R^9	SMIGLCARRRRRRRRR (SEQ ID NO: 19)
20-R^9	MIGLCARRRRRRRRR (SEQ ID NO: 20)
21-R^9	IGLCARRRRRRRRR (SEQ ID NO: 21)
22-R^9	YIKVQKQDIVKLTVYDCISMIGLCRRRRRRRRR (SEQ ID NO: 22)
23-R^9	YIKVQKQDIVKLTVYDCISMIGLRRRRRRRRR (SEQ ID NO: 23)
24-R^9	YIKVQKQDIVKLTVYDCISMIGRRRRRRRRR (SEQ ID NO: 24)
25-R^9	YIKVQKQDIVKLTVYDCISMIRRRRRRRRR (SEQ ID NO: 25)
26-R^9	YIKVQKQDIVKLTVYDCISMRRRRRRRRR (SEQ ID NO: 26)
27-R^9	YIKVQKQDIVKLTVYDCISRRRRRRRRR (SEQ ID NO: 27)
28-R^9	YIKVQKQDIVKLTVYDCIRRRRRRRRR (SEQ ID NO: 28)
29-R^9	YIKVQKQDIVKLTVYDCRRRRRRRRR (SEQ ID NO: 29)
30-R^9	YIKVQKQDIVKLTVYDRRRRRRRRR (SEQ ID NO: 30)
31-R^9	YIKVQKQDIVKLTVYRRRRRRRRR (SEQ ID NO: 31)
32-R^9	YIKVQKQDIVKLTVRRRRRRRRR (SEQ ID NO: 32)
33-R^9	YIKVQKQDIVKLTRRRRRRRRR (SEQ ID NO: 33)
34-R^9	YIKVQKQDIVKLRRRRRRRRR (SEQ ID NO: 34)

35-R^9	YIKVQKQDIVKRRRRRRRRR (SEQ ID NO: 35)
36-R^9	YIKVQKQDIVRRRRRRRRR (SEQ ID NO: 36)
37-R^9	YIKVQKQDIRRRRRRRRR (SEQ ID NO: 37)
38-R^9	YIKVQKQDRRRRRRRRR (SEQ ID NO: 38)
39-R^9	YIKVQKQRRRRRRRRR (SEQ ID NO: 39)
40-R^9	YIKVQKRRRRRRRRR (SEQ ID NO: 40)
41-R^9	YIKVQRRRRRRRRR (SEQ ID NO: 41)
42 (S1) - R^9	EMFTILEEYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 42)
43 (S2) - R^9	MFTILEEYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 43)
44 (S3) - R^9	FTILEEYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 44)
45-R^9	TILEEYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 45)
46-R^9	ILEEYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 46)
47-R^9	LEEYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 47)
48-R^9	EEYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 48)
49-R^9	EYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 49)
50-R^9	YFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 50)
51-R^9	FMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 51)
52-R^9	MYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 52)
53-R^9	YRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 53)
54-R^9	RGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 54)
55-R^9	GLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 55)
56-R^9	LLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 56)
57-R^9	LGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 57)
58-R^9	GLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 58)
59-R^9	LRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 59)
60-R^9	RIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 60)
61-R^9	IKYGRLFNEIRRRRRRRRR (SEQ ID NO: 61)
62-R^9	KYGRLFNEIRRRRRRRRR (SEQ ID NO: 62)
63-R^9	YGRLFNEIRRRRRRRRR (SEQ ID NO: 63)
64-R^9	GRLFNEIRRRRRRRRR (SEQ ID NO: 64)
65-R^9	RLFNEIRRRRRRRRR (SEQ ID NO: 65)
66-R^9	LFNEIRRRRRRRRR (SEQ ID NO: 66)
67-R^9	EMFTILEEYFMYRGLLGLRIKYGRLFNERRRRRRRRR (SEQ ID NO: 67)
68 (S4) - R^9	EMFTILEEYFMYRGLLGLRIKYGRLFNRRRRRRRRR (SEQ ID NO: 68)
69 (S5) - R^9	EMFTILEEYFMYRGLLGLRIKYGRLFRRRRRRRRR (SEQ ID NO: 69)
70 (S6) - R^9	EMFTILEEYFMYRGLLGLRIKYGRLRRRRRRRRR (SEQ ID NO: 70)
71 (S7) - R^9	EMFTILEEYFMYRGLLGLRIKYGRRRRRRRRRR (SEQ ID NO: 71)
72 (S8) - R^9	EMFTILEEYFMYRGLLGLRIKYGRRRRRRRRR (SEQ ID NO: 72)
73 (S9) -	EMFTILEEYFMYRGLLGLRIKYRRRRRRRRR (SEQ ID NO: 73)

R^9	
74 (S10) -R^9	EMFTILEEYFMYRGLLGLRIKRRRRRRRRR (SEQ ID NO: 74)
75 (S11) -R^9	EMFTILEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 75)
76 (S12) -R^9	EMFTILEEYFMYRGLLGLRRRRRRRRRR (SEQ ID NO: 76)
77 (S13) -R^9	EMFTILEEYFMYRGLLGLRRRRRRRRR (SEQ ID NO: 77)
78-R^9	EMFTILEEYFMYRGLLGRRRRRRRRR (SEQ ID NO: 78)
79 (S14) -R^9	EMFTILEEYFMYRGLLRRRRRRRRR (SEQ ID NO: 79)
80 (S15) -R^9	EMFTILEEYFMYRGLRRRRRRRRR (SEQ ID NO: 80)
81 (S16) -R^9	EMFTILEEYFMYRGRRRRRRRRR (SEQ ID NO: 81)
82-R^9	EMFTILEEYFMYRRRRRRRRRR (SEQ ID NO: 82)
83 (S17) -R^9	EMFTILEEYFMYRRRRRRRRR (SEQ ID NO: 83)
84-R^9	EMFTILEEYFMRRRRRRRRR (SEQ ID NO: 84)
85-R^9	EMFTILEEYFRRRRRRRRR (SEQ ID NO: 85)
86-R^9	EMFTILEEYRRRRRRRRR (SEQ ID NO: 86)
87-R^9	EMFTILEERRRRRRRRR (SEQ ID NO: 87)
88-R^9	EMFTILERRRRRRRRR (SEQ ID NO: 88)
89-R^9	EMFTILRRRRRRRRR (SEQ ID NO: 89)
90-R^9	EMFTIRRRRRRRRR (SEQ ID NO: 90)
91-R^9	MFTILLEEYFMYRGLLRRRRRRRRR (SEQ ID NO: 91)
92-R^9	FTILLEEYFMYRGLLRRRRRRRRR (SEQ ID NO: 92)
93-R^9	TILLEEYFMYRGLLRRRRRRRRR (SEQ ID NO: 93)
94-R^9	ILLEEYFMYRGLLRRRRRRRRR (SEQ ID NO: 94)
95-R^9	LLEEYFMYRGLLRRRRRRRRR (SEQ ID NO: 95)
96-R^9	LEEYFMYRGLLRRRRRRRRR (SEQ ID NO: 96)
97-R^9	EYFMYRGLLRRRRRRRRR (SEQ ID NO: 97)
98-R^9	YFMYRGLLRRRRRRRRR (SEQ ID NO: 98)
99-R^9	FMYRGLLRRRRRRRRR (SEQ ID NO: 99)
100-R^9	MYRGLLRRRRRRRRR (SEQ ID NO: 100)
101-R^9	YRGLLRRRRRRRRR(SEQ ID NO: 101)
102 (S18) -R^9	MFTILEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 102)
103 (S19) -R^9	FTILLEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 103)
104 (S20) -R^9	TILLEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 104)
105 (S21) -R^9	ILLEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 105)
106 (S22) -R^9	LLEEYFMYGLLGLRIRRRRRRRRR (SEQ ID NO: 106)
107-R^9	EYFMYRGLLGLRIKYGRRRRRRRRR (SEQ ID NO: 107)

108-R^9	YFMYRGLLGLRIKYGRRRRRRRRRR (SEQ ID NO: 108)
109-R^9	FMYRGLLGLRIKYGRRRRRRRRRR (SEQ ID NO: 109)
110-R^9	MYRGLLGLRIKYGRRRRRRRRRR (SEQ ID NO: 110)
111-R^9	YRGLLGLRIKYGRRRRRRRRRR (SEQ ID NO: 111)
112-R^9	RGLLGLRIKYGRRRRRRRRR (SEQ ID NO: 112)
113-R^9	GLLGLRIKYGRRRRRRRRR (SEQ ID NO: 113)
114-R^9	LLGLRIKYGRRRRRRRRR (SEQ ID NO: 114)
115-R^9	LGLRIKYGRRRRRRRRR (SEQ ID NO: 115)
116-R^9	GLRIKYGRRRRRRRRR (SEQ ID NO: 116)
117-R^9	LRIKYGRRRRRRRRR (SEQ ID NO: 117)
118-R^9	RIKYGRRRRRRRRR (SEQ ID NO: 118)
119-R^9	EEYFMRRRRRRRRR (SEQ ID NO: 119)
120-R^9	EEYFMYRRRRRRRRR (SEQ ID NO: 120)
121-R^9	EEYFMYRRRRRRRRRR (SEQ ID NO: 121)
122-R^9	EEYFMYRGRRRRRRRRR (SEQ ID NO: 122)
123-R^9	EEYFMYRGLRRRRRRRRR (SEQ ID NO: 123)
124-R^9	EEYFMYRGLLRRRRRRRRR (SEQ ID NO: 124)
125-R^9	EEYFMYRGLLGRRRRRRRRR (SEQ ID NO: 125)
126-R^9	EEYFMYRGLLGLRRRRRRRRR (SEQ ID NO: 126)
127-R^9	EEYFMYRGLLGLRRRRRRRRRR (SEQ ID NO: 127)
128-R^9	EEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 128)
129-R^9	EEYFMYRGLLGLRIKRRRRRRRRR (SEQ ID NO: 129)
130-R^9	EEYFMYRGLLGLRIKYRRRRRRRRR (SEQ ID NO: 130)
T1-R^9	IVKLTVYDCIRRRRRRRRR (SEQ ID NO: 131)
T2-R^9	DIVKLTVYDCRRRRRRRRR (SEQ ID NO: 132)
T3-R^9	AIVKLTVYDCIRRRRRRRRR (SEQ ID NO: 133)
T4-R^9	DAVKLTVYDCIRRRRRRRRR (SEQ ID NO: 134)
T5-R^9	DIAKLTVYDCIRRRRRRRRR (SEQ ID NO: 135)
T6-R^9	DIVALTVYDCIRRRRRRRRR (SEQ ID NO: 136)
T7-R^9	DIVKATVYDCIRRRRRRRRR (SEQ ID NO: 137)
T8-R^9	DIVKLAVYDCIRRRRRRRRR (SEQ ID NO: 138)
T9-R^9	DIVKLTAYDCIRRRRRRRRR (SEQ ID NO: 139)
T10-R^9	DIVKLTVADCIRRRRRRRRR (SEQ ID NO: 140)
T11-R^9	DIVKLTVYACIRRRRRRRRR (SEQ ID NO: 141)
T12-R^9	DIVKLTVYDAIRRRRRRRRR (SEQ ID NO: 142)
T13-R^9	DIVKLTVYDCARRRRRRRRR (SEQ ID NO: 143)
T14-R^9	EIVKLTVYDCIRRRRRRRRR (SEQ ID NO: 144)
T15-R^9	DIVKLTVYECIRRRRRRRRR (SEQ ID NO: 145)
T16-R^9	DIVRLTVYDCIRRRRRRRRR (SEQ ID NO: 146)
T17-R^9	DIVHLTVYDCIRRRRRRRRR (SEQ ID NO: 147)
T18-R^9	KIVKLTVYKCIRRRRRRRRR (SEQ ID NO: 148)
T19-R^9	DIVELTVYDCIRRRRRRRRR (SEQ ID NO: 149)
T20-R^9	DIVKLSVYDCIRRRRRRRRR (SEQ ID NO: 150)
T21-R^9	DIVKLYVYDCIRRRRRRRRR (SEQ ID NO: 151)
T22-R^9	DIVKLTVSDCIRRRRRRRRR (SEQ ID NO: 152)
T23-R^9	DIVKLTVTDCIRRRRRRRRR (SEQ ID NO: 153)
T24-R^9	DIVKLTVWDCIRRRRRRRRR (SEQ ID NO: 154)

T25-R^9	DIVKLTVFDCIRRRRRRRRR (SEQ ID NO: 155)
T26-R^9	DIVKLTVYDMIRRRRRRRRR (SEQ ID NO: 156)
T27-R^9	DIVKLTVYDSIRRRRRRRRR (SEQ ID NO: 157)
T28-R^9	DIVKLTVYDXaaIRRRRRRRRR (SEQ ID NO: 158)
T29-R^9	DIVKLTVYDXaaIRRRRRRRRR (SEQ ID NO: 159)
T30-R^9	DIVKLTVYDXaaIRRRRRRRRR (SEQ ID NO: 160)
T31-R^9	DIVKLTVYDXaaIRRRRRRRRR (SEQ ID NO: 161)
T32-R^9	DIVKLTVYDXaaIRRRRRRRRR (SEQ ID NO: 162)
T33-R^9	DLVKLTVYDCIRRRRRRRRR (SEQ ID NO: 163)
T34-R^9	DVVKLTVYDCIRRRRRRRRR (SEQ ID NO: 164)
T35-R^9	DILKLTVYDCIRRRRRRRRR (SEQ ID NO: 165)
T36-R^9	DIIKLTVYDCIRRRRRRRRR (SEQ ID NO: 166)
T37-R^9	DIVKVTVYDCIRRRRRRRRR (SEQ ID NO: 167)
T38-R^9	DIVKITVYDCIRRRRRRRRR (SEQ ID NO: 168)
T39-R^9	DIVKLTLYDCIRRRRRRRRR (SEQ ID NO: 169)
T40-R^9	DIVKLTIYDCIRRRRRRRRR (SEQ ID NO: 170)
T41-R^9	DIVKLTVYDCLRRRRRRRRR (SEQ ID NO: 171)
T42-R^9	DIVKLTVYDCVRRRRRRRRR (SEQ ID NO: 172)
T43-R^9	DIDKLTEYDSIRRRRRRRRR (SEQ ID NO: 173)
T44-R^9	DIPKLGVPDCIRRRRRRRRR (SEQ ID NO: 174)
T45-R^9	ICDYVTLKVIDRRRRRRRRR (SEQ ID NO: 175)
T46-R^9	VDLVIDCIYKTRRRRRRRRR (SEQ ID NO: 176)
T47-R^9	DIVKLTVYDCIDIVKLTVYDCIRRRRRRRRR (SEQ ID NO: 177)
T48-R^9	IVKLTVYDCIRRRRRRRRR (N-succinyl) (SEQ ID NO: 178)
T49-R^9	DIVKLTVYDCIGRRRRRRRRR (SEQ ID NO: 179)
T50-R^9	DIVKLTVYDCIRRRRRRRRR (N-acetyl) (SEQ ID NO: 180)
T51-R^9	AIVKLTVYACIRRRRRRRRR (SEQ ID NO: 181)
T52-R^9	AIIKVYVYACIRRRRRRRRR (SEQ ID NO: 182)
T53	D-Asp-D-Ile-D-Val-D-Lys-D-Leu-D-Thr-D-Val-D-Tyr-D-Asp-D-Cys-D-Ile-Arg-Arg-Arg-Arg-Arg-Arg-Arg-Arg-Arg (SEQ ID NO: 183)
T54	D-Asp-D-Ile-D-Val-D-Lys-D-Leu-D-Thr-D-Val-D-Tyr-D-Asp-D-Cys-D-Ile-D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg (SEQ ID NO: 184)
T55	D-Asp-D-Ile-D-Val-D-Lys-D-Leu-D-Thr-D-Val-D-Tyr-D-Asp-D-Cys-D-Ile (SEQ ID NO: 185)
T56	Asp-Ile-Val-Lys-Leu-Thr-Val-Tyr-Asp-Cys-Ile-D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg (SEQ ID NO: 186)
1	YIKVQKQDIVKLTVYDCISMIGLCA (SEQ ID NO: 187)
2	IKVQKQDIVKLTVYDCISMIGLCA (SEQ ID NO: 188)
3	KVQKQDIVKLTVYDCISMIGLCA (SEQ ID NO: 189)
4	VQKQDIVKLTVYDCISMIGLCA (SEQ ID NO: 190)
5	QKQDIVKLTVYDCISMIGLCA (SEQ ID NO: 191)
6	KQDIVKLTVYDCISMIGLCA (SEQ ID NO: 192)
7	QDIVKLTVYDCISMIGLCA (SEQ ID NO: 193)
8	DIVKLTVYDCISMIGLCA (SEQ ID NO: 194)
9	IVKLTVYDCISMIGLCA (SEQ ID NO: 195)
10	VKLTVYDCISMIGLCA (SEQ ID NO: 196)

11	KLTVYDCISMIGLCA (SEQ ID NO: 197)
12	LTVYDCISMIGLCA (SEQ ID NO: 198)
13	TVYDCISMIGLCA (SEQ ID NO: 199)
14	VYDCISMIGLCA (SEQ ID NO: 200)
15	YDCISMIGLCA (SEQ ID NO: 201)
16	DCISMIGLCA (SEQ ID NO: 202)
17	CISMIGLCA (SEQ ID NO: 203)
18	ISMIGLCA (SEQ ID NO: 204)
19	SMIGLCA (SEQ ID NO: 205)
20	MIGLCA (SEQ ID NO: 206)
21	IGLCA (SEQ ID NO: 207)
22	YIKVQKQDIVKLTVYDCISMIGLC (SEQ ID NO: 208)
23	YIKVQKQDIVKLTVYDCISMIGL (SEQ ID NO: 209)
24	YIKVQKQDIVKLTVYDCISMIG (SEQ ID NO: 210)
25	YIKVQKQDIVKLTVYDCISMI (SEQ ID NO: 211)
26	YIKVQKQDIVKLTVYDCISM (SEQ ID NO: 212)
27	YIKVQKQDIVKLTVYDCIS (SEQ ID NO: 213)
28	YIKVQKQDIVKLTVYDCI (SEQ ID NO: 214)
29	YIKVQKQDIVKLTVYDC (SEQ ID NO: 215)
30	YIKVQKQDIVKLTVYD (SEQ ID NO: 216)
31	YIKVQKQDIVKLTVY (SEQ ID NO: 217)
32	YIKVQKQDIVKLTV (SEQ ID NO: 218)
33	YIKVQKQDIVKLT (SEQ ID NO: 219)
34	YIKVQKQDIVKL (SEQ ID NO: 220)
35	YIKVQKQDIVK (SEQ ID NO: 221)
36	YIKVQKQDIV (SEQ ID NO: 222)
37	YIKVQKQDI (SEQ ID NO: 223)
38	YIKVQKQD (SEQ ID NO: 224)
39	YIKVQKQ (SEQ ID NO: 225)
40	YIKVQK (SEQ ID NO: 226)
41	YIKVQ (SEQ ID NO: 227)
42 (S1)	EMFTILEEYFMYRGLLGLRIKYGRLFNEI (SEQ ID NO: 228)
43 (S2)	MFTILEEYFMYRGLLGLRIKYGRLFNEI (SEQ ID NO: 229)
44 (S3)	FTILEEYFMYRGLLGLRIKYGRLFNEI (SEQ ID NO: 230)
45	TILEEYFMYRGLLGLRIKYGRLFNEI (SEQ ID NO: 231)
46	ILEEYFMYRGLLGLRIKYGRLFNEI (SEQ ID NO: 232)
47	LEEYFMYRGLLGLRIKYGRLFNEI (SEQ ID NO: 233)
48	EEYFMYRGLLGLRIKYGRLFNEI (SEQ ID NO: 234)
49	EYFMYRGLLGLRIKYGRLFNEI (SEQ ID NO: 235)
50	YFMYRGLLGLRIKYGRLFNEI (SEQ ID NO: 236)
51	FMYRGLLGLRIKYGRLFNEI (SEQ ID NO: 237)
52	MYRGLLGLRIKYGRLFNEI (SEQ ID NO: 238)
53	YRGLLGLRIKYGRLFNEI (SEQ ID NO: 239)
54	RGLLGLRIKYGRLFNEI (SEQ ID NO: 240)
55	GLLGLRIKYGRLFNEI (SEQ ID NO: 241)
56	LLGLRIKYGRLFNEI (SEQ ID NO: 242)
57	LGLRIKYGRLFNEI (SEQ ID NO: 243)

58	GLRIKYGRLFNEI (SEQ ID NO: 244)
59	LRIKYGRLFNEI (SEQ ID NO: 245)
60	RIKYGRLFNEI (SEQ ID NO: 246)
61	IKYGRLFNEI (SEQ ID NO: 247)
62	KYGRLFNEI (SEQ ID NO: 248)
63	YGRLFNEI (SEQ ID NO: 249)
64	GRLFNEI (SEQ ID NO: 250)
65	RLFNEI (SEQ ID NO: 251)
66	LFNEI (SEQ ID NO: 252)
67	EMFTILEEYFMYRGLLGLRIKYGRLFNE (SEQ ID NO: 253)
68 (S4)	EMFTILEEYFMYRGLLGLRIKYGRLFN (SEQ ID NO: 254)
69 (S5)	EMFTILEEYFMYRGLLGLRIKYGRLF (SEQ ID NO: 255)
70 (S6)	EMFTILEEYFMYRGLLGLRIKYGRL (SEQ ID NO: 256)
71 (S7)	EMFTILEEYFMYRGLLGLRIKYG R (SEQ ID NO: 257)
72 (S8)	EMFTILEEYFMYRGLLGLRIKYG (SEQ ID NO: 258)
73 (S9)	EMFTILEEYFMYRGLLGLRIKY (SEQ ID NO: 259)
74 (S10)	EMFTILEEYFMYRGLLGLRIK (SEQ ID NO: 260)
75 (S11)	EMFTILEEYFMYRGLLGLRI (SEQ ID NO: 261)
76 (S12)	EMFTILEEYFMYRGLLGL R (SEQ ID NO: 262)
77 (S13)	EMFTILEEYFMYRGLLGL (SEQ ID NO: 263)
78	EMFTILEEYFMYRGLLG (SEQ ID NO: 264)
79 (S14)	EMFTILEEYFMYRGLL (SEQ ID NO: 265)
80 (S15)	EMFTILEEYFMYRGL (SEQ ID NO: 266)
81 (S16)	EMFTILEEYFMYRG (SEQ ID NO: 267)
82	EMFTILEEYFMY R (SEQ ID NO: 268)
83 (S17)	EMFTILEEYFMY (SEQ ID NO: 269)
84	EMFTILEEYFM (SEQ ID NO: 270)
85	EMFTILEEYF (SEQ ID NO: 271)
86	EMFTILEEY (SEQ ID NO: 272)
87	EMFTILEE (SEQ ID NO: 273)
88	EMFTILE (SEQ ID NO: 274)
89	EMFTIL (SEQ ID NO: 275)
90	EMFTI (SEQ ID NO: 276)
91	MFTILLEEYFMYRGLL (SEQ ID NO: 277)
92	FTILLEEYFMYRGLL (SEQ ID NO: 278)
93	TILLEEYFMYRGLL (SEQ ID NO: 279)
94	ILLEEYFMYRGLL (SEQ ID NO: 280)
95	LLEEYFMYRGLL (SEQ ID NO: 281)
96	LEEYFMYRGLL (SEQ ID NO: 282)
97	EYFMYRGLL (SEQ ID NO: 283)
98	YFMYRGLL (SEQ ID NO: 284)
99	FMYRGLL (SEQ ID NO: 285)
100	MYRGLL (SEQ ID NO: 286)
101	YRGLL (SEQ ID NO: 287)
102 (S18)	MFTILEEYFMYRGLLGLRI (SEQ ID NO: 288)
103	FTILLEEYFMYRGLLGLRI (SEQ ID NO: 289)

(S19)	
104 (S20)	TILLEEYFMYRGLLGLRI (SEQ ID NO: 290)
105 (S21)	ILLEEYFMYRGLLGLRI (SEQ ID NO: 291)
106 (S22)	LLEEYFMYGLLGLRI (SEQ ID NO: 292)
107	EYFMYRGLLGLRIKYG (SEQ ID NO: 293)
108	YFMYRGLLGLRIKYG (SEQ ID NO: 294)
109	FMYRGLLGLRIKYG (SEQ ID NO: 295)
110	MYRGLLGLRIKYG (SEQ ID NO: 296)
111	YRGLLGLRIKYG (SEQ ID NO: 297)
112	RGLLGLRIKYG (SEQ ID NO: 298)
113	GLLGLRIKYG (SEQ ID NO: 299)
114	LLGLRIKYG (SEQ ID NO: 300)
115	LGLRIKYG (SEQ ID NO: 301)
116	GLRIKYG (SEQ ID NO: 302)
117	LRIKYG (SEQ ID NO: 303)
118	RIKYG (SEQ ID NO: 304)
119	EEYFM (SEQ ID NO: 305)
120	EEYFMY (SEQ ID NO: 306)
121	EEYFMY R (SEQ ID NO: 307)
122	EEYFMYRG (SEQ ID NO: 308)
123	EEYFMYRGL (SEQ ID NO: 309)
124	EEYFMYRGLL (SEQ ID NO: 310)
125	EEYFMYRGLLG (SEQ ID NO: 311)
126	EEYFMYRGLLGL (SEQ ID NO: 312)
127	EEYFMYRGLLGL R (SEQ ID NO: 313)
128	EEYFMYRGLLGLRI (SEQ ID NO: 314)
129	EEYFMYRGLLGLRIK (SEQ ID NO: 315)
130	EEYFMYRGLLGLRIKY (SEQ ID NO: 316)
T1	IVKLTVYDCI (SEQ ID NO: 317)
T2	DIVKLTVYDC (SEQ ID NO: 318)
T3	AIVKLTVYDCI (SEQ ID NO: 319)
T4	DAVKLTVYDCI (SEQ ID NO: 320)
T5	DIAKLTVYDCI (SEQ ID NO: 321)
T6	DIVALTVYDCI (SEQ ID NO: 322)
T7	DIVKATVYDCI (SEQ ID NO: 323)
T8	DIVKLAVYDCI (SEQ ID NO: 324)
T9	DIVKLTAYDCI (SEQ ID NO: 325)
T10	DIVKLTVADCI (SEQ ID NO: 326)
T11	DIVKLTVYACI (SEQ ID NO: 327)
T12	DIVKLTVYDAI (SEQ ID NO: 328)
T13	DIVKLTVYDCA (SEQ ID NO: 329)
T14	EIVKLTVYDCI (SEQ ID NO: 330)
T15	DIVKLTVYECI (SEQ ID NO: 331)
T16	DIVRLTVYDCI (SEQ ID NO: 332)

T17	DIVHLTVYDCI (SEQ ID NO: 333)
T18	KIVKLTVYKCI (SEQ ID NO: 334)
T19	DIVELTVYDCI (SEQ ID NO: 335)
T20	DIVKLSVYDCI (SEQ ID NO: 336)
T21	DIVKLYVYDCI (SEQ ID NO: 337)
T22	DIVKLTVSDCI (SEQ ID NO: 338)
T23	DIVKLTVTDCI (SEQ ID NO: 339)
T24	DIVKLTVWDCI (SEQ ID NO: 340)
T25	DIVKLTVFDCI (SEQ ID NO: 341)
T26	DIVKLTVYDMI (SEQ ID NO: 342)
T27	DIVKLTVYDSI (SEQ ID NO: 343)
T28	DIVKLTVYDXaaI (SEQ ID NO: 344)
T29	DIVKLTVYDXaaI (SEQ ID NO: 345)
T30	DIVKLTVYDXaaI (SEQ ID NO: 346)
T31	DIVKLTVYDXaaI (SEQ ID NO: 347)
T32	DIVKLTVYDXaaI (SEQ ID NO: 348)
T33	DLVKLTVYDCI (SEQ ID NO: 349)
T34	DVVKLTVYDCI (SEQ ID NO: 350)
T35	DILKLTVYDCI (SEQ ID NO: 351)
T36	DIIKLTVYDCI (SEQ ID NO: 352)
T37	DIVKVTVYDCI (SEQ ID NO: 353)
T38	DIVKITVYDCI (SEQ ID NO: 354)
T39	DIVKLTLYDCI (SEQ ID NO: 355)
T40	DIVKLTIYDCI (SEQ ID NO: 356)
T41	DIVKLTVYDCL (SEQ ID NO: 357)
T42	DIVKLTVYDCV (SEQ ID NO: 358)
T43	DIDKLTEYDSI (SEQ ID NO: 359)
T44	DIPKLGVPDCI (SEQ ID NO: 360)
T45	ICDYVTLKVID (SEQ ID NO: 361)
T46	VDLVIDCIYKT (SEQ ID NO: 362)
T47	DIVKLTVYDCIDIVKLTVYDCI (SEQ ID NO: 363)
T48	IVKLTVYDCI (N-succinyl) (SEQ ID NO: 364)
T49	DIVKLTVYDCIG (SEQ ID NO: 365)
T50	DIVKLTVYDCI (N-acetyl) (SEQ ID NO: 366)
T51	AIVKLTVYACI (SEQ ID NO: 367)
T52	AIIKVYVYACI (SEQ ID NO: 368)

Legend to Table 1:
Xaa in peptide T31 and T31-R^9 is α-Aminobutyric acid;
Xaa in peptide T32 and T32-R^9 is L-Norvaline;
Xaa in peptide T30 and T30-R^9 is L-Cysteine(S-Acm);
Xaa in peptide T28 and T28-R^9 is L-Cysteine(S-carboxymethyl); and
Xaa in peptide T29 and T29-$R^9$is L-Cysteine(S-carbamidomethyl).

[0036] Peptides of the invention and compositions comprising the same are effective to modulate cellular activity. In some embodiments, modulating cellular activity is accomplished by modulating cellular signaling. Activities can be regulated, for example, by

a toll-like receptor. In some embodiments, peptides and compositions of the invention inhibit cytokine secretion. In some embodiments, peptides and compositions of the invention enhance cytokine secretion. In some embodiments, cytokine secretion is in response to toll-like receptor-dependent stimulation.

[0037] In some embodiments, administration of a peptide derived from A52R or P13 can inhibit cytokine secretion by at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90%. In some embodiments, administration of a peptide derived from A52R or P13 can enhance cytokine secretion by 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90%. In some embodiments the cytokine secretion is a result of TLR-dependent signaling.

[0038] In some embodiments, the activity mediated by a toll-like receptor is TNF-α secretion. Peptides and compositions of the invention are effective to provide 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% inhibition of TNF-α secretion following stimulation by LPS. Peptides and compositions of the invention are effective to provide 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% inhibition of TNF-α secretion following stimulation by CpG-ODN. Peptides and compositions of the invention are effective to provide 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% inhibition of TNF-α secretion following stimulation by LPS and/or CpG-ODN. Peptides and compositions of the invention are effective to provide 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% enhancement of TNF-α secretion following stimulation by LPS. Peptides and compositions of the invention are effective to provide 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% enhancement of TNF-α secretion following stimulation by CpG-ODN. Peptides and compositions of the invention are effective to provide 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% enhancement of TNF-α secretion following stimulation by LPS and/or CpG-ODN.

[0039] Some embodiments of the invention contemplate a peptide comprising the amino acid sequence DIVKLTVYDCI (SEQ ID NO: 369), linked to a 9-arginine cell transduction sequence or other type of cell transduction sequence. The peptide DIVKLTVYDCIRRRRRRRRR (SEQ ID NO: 378) effectively inhibits cytokine secretion in response to TLR activation. The peptide had no effect on cytokine secretion resulting from cell activation that was initiated independent of TLR stimulation. Employing a mouse model of otitis media with effusion (OME), administration of heat-inactivated Streptococcus pneumoniae (S. pneumoniae) into the middle ears of BALB/c mice resulted in a significant inflammatory response that was dramatically reduced with peptide treatment. Experiments have also demonstrated that the peptide will reduce pro-inflammatory mediators in a mouse

model of LPS-induced septic shock. The peptide is effective in the treatment of chronic inflammation initiated by bacterial or viral infections.

[0040] In some embodiments, the invention contemplates a pharmaceutical composition effective to:

a) decrease the amount of an middle ear fluid by about 30-80 %;

b) decrease infiltrating cell number in middle ear fluid by about 30-80%; and

c) decrease the thickness of a tympanic membrane by about 30-80% in a mouse comprising inflammation of the ear, wherein the composition is administered to the mouse in an amount of about 0.1 μg to 60 μg. In some embodiments, the pharmaceutical composition is an aural pharmaceutical composition. In some embodiments, the pharmaceutical composition is formulated for intra-aural administration. In some embodiments, the pharmaceutical composition is formulated as a drop. In some embodiments, the pharmaceutical composition is formulated as an ear drop.

[0041] In some embodiments, a pharmaceutical composition of the invention comprises a peptide. In some embodiments, the peptide is P13 or a variant, derivative, stereoisomer, or analogue thereof. In some embodiments, the peptide is P13, a peptide comprising P13 and a poly-argenine domain, or a peptide of Table 1. In some embodiments, the peptide is P13. In some embodiments, the peptide is derived from A52R. In some embodiments, the peptide is a peptide of S1-S22. The invention also contemplates a method of treating ear inflammation in an animal in need or want thereof, the method comprising administering to the animal a pharmaceutical composition of the invention.

[0042] The in vivo effectiveness of P13 was demonstrated using a mouse model of otitis media (OM). OM is an inflammatory disease of the middle ear accompanied by fluid accumulation. It is characterized by an infiltration of leukocytes, macrophages, and mast cells and a release of inflammatory mediators and enzymes (Reference 21). These mediators increase vascular permeability and secretory activity, and initiate a cascade of inflammatory events, resulting in fluid accumulation and mucin secretion (References 26 and 27). The initiation of inflammation in OM has been attributed to a variety of factors, including bacterial or viral infections, Eustachian tube dysfunction, and allergy. However, the evidence points to a bacterial etiology leading to cytokine activation in the majority of cases. Bacteria have been cultured from up to 40% of effusions and studies have shown bacterial DNA by PCR in approximately 80% of effusions, often in the absence of viable organisms in culture (Reference 28). The most common bacteria invading the middle ear are S. pneumoniae, H.

influenzae, and M. catarralis. These three bacteria account for 85% of acute middle ear infections (Reference 27), with S. pneumoniae being the most frequent cause. Initially, live bacteria trigger acute inflammation, which is designed to eliminate the pathogen. During acute infection, interference with the innate immune response would be potentially harmful to the host and can lead to further bacterial spread. Acute inflammation initiated by bacterial infections self-resolves or is treatable by antibiotics. Chronic inflammation involves continued activation of the immune system, often by non-viable bacterial products. OM is often prolonged or anti-biotic resistant, suggesting TLR stimulation in the absence of live bacteria.

[0043] Treatment of mice with P13 in the experiments disclosed herein resulted in a significant reduction in bacterial-induced inflammation in the middle ear. Fluid accumulation, infiltrating cells, and tympanic membrane thickness in the middle ear were all dramatically reduced with peptide treatment. Administration of heat-inactivated bacteria, which have a number of potential TLR ligands, induced an inflammatory response in the middle ear most likely resulting from activation of multiple TLRs. The use of heat-inactivated bacteria allowed for an examination of peptide inhibition of inflammation without the potential for the bacterial spread that can occur in an acute infection initiated with live bacteria. The ability of peptide P13 to inhibit this response significantly in vivo is consistent with the in vitro data showing inhibition of cytokine secretion in response to multiple TLR ligands used either individually or in combination. In these studies, a single dose of peptide was administered at the same time as heat-inactivated S. pneumoniae into the middle ears of normal BALB/c mice. The in vitro data also showed inhibition of cytokine secretion even when peptide P13 was added several hours after initiation of TLR activation.

[0044] In addition to P13 and the peptides of Table 1, the invention disclosed herein also contemplates peptides more broadly characterized as variants, derivatives, stereoisomers, or analogues of any peptide of the instant invention. These terms are not exclusive, and can be contemplated in concert to describe peptides that are described by one or more of the terms. Many such peptides, not all of which are expressly disclosed herein, are contemplated as peptides, as components of a formulation or pharmaceutical composition, and as elements of the methods and uses of the instant invention.

[0045] In some embodiments, the variant, derivative, stereoisomer, or analogue of a peptide of the invention comprises a peptide comprising a peptide of the invention and a poly-argenine sequence. In some embodiments, the variant, derivative, stereoisomer, or analogue

of a peptide of the invention comprises one or more D-amino acid residues. In some embodiments, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, or 50 of the amino acid residues of the variant, derivative, stereoisomer, or analogue of a peptide of the invention possess the D-configuration. In some embodiments, all the amino acid residues of the variant, derivative, stereoisomer, or analogue of a peptide of the invention possess the D-configuration.

[0046] In some embodiments, the variant, derivative, stereoisomer, or analogue of a peptide of the invention comprises one or more D-amino acid residues in the region of the peptide analogous to or derived from a peptide of the invention. In some embodiments, the region of the peptide analogous to or derived from P13 comprises more than one D-amino acid residue.

[0047] In some embodiments, the region of the peptide analogous to or derived from a peptide of the invention comprises a D-amino acid residue. In some embodiments, the poly-argenine sequence comprises a D-amino acid residue. In some embodiments, the poly-argenine sequence comprises more than one D-amino acid residue. In some embodiments, either the region of the peptide analogous to or derived from a peptide of the invention or the poly-argenine sequence comprises a D-amino acid residue. In some embodiments, either the region of the peptide analogous to or derived from a peptide of the invention or the poly-argenine sequence comprises more than one D-amino acid residue. In some embodiments, both the region of the peptide analogous to or derived from a peptide of the invention and the poly-argenine sequence independently comprise a D-amino acid residue. In some embodiments, both the region of the peptide analogous to or derived from a peptide of the invention and the poly-argenine sequence independently comprise more than one D-amino acid residue.

[0048] In some embodiments comprising a peptide comprising a variant, derivative, stereoisomer, or analogue of a peptide of the invention comprising a poly-argenine sequence, the region of the peptide analogous to or derived from P13 consists of D-amino acid residues. In some embodiments, the region of the peptide analogous to or derived from a peptide of the invention consists of D-amino acid residues, and the poly-argenine sequence consists of L-amino acid residues. In some embodiments, the region of the peptide analogous to or derived from a peptide of the invention consists of D-amino acid residues, and the poly-argenine sequence comprises one or more D-amino acid residues.

[0049] In some embodiments, the poly-argenine sequence consists of D-amino acid residues. In some embodiments, the poly-argenine sequence consists of D-amino acid residues, and the region of the peptide analogous to or derived from a peptide of the invention consists of L-amino acid residues. In some embodiments, the poly-argenine sequence consists of D-amino acid residues, and the region of the peptide analogous to or derived from a peptide of the invention comprises one or more D-amino acid residues.

[0050] In some embodiments comprising a peptide comprising a variant, derivative, stereoisomer, or analogue of a peptide of the invention comprising a poly-argenine sequence, the peptide consists of D-amino acid residues.

[0051] In some embodiments, a peptide comprises an amino acid residue comprising a stereogenic side chain, for example, threonine, *allo*-threonine, isoleucine, or *allo*-isoleucine. In some embodiments, a peptide comprises a D-*allo*-threonine, or D-*allo*-isoleucine residue.

Diseases

[0052] The initiation of an inflammatory response to pathogens is a component of the innate immune response and is designed to control infection. However, the sustained production of inflammatory mediators can lead to chronic inflammation, tissue damage and disease development. The signaling cascade initiated by PAMP/TLR interactions and culminating in cell activation has been associated with many disease states, including otitis media, inner ear inflammation, sepsis, autoimmune diseases, asthma, heart disease and cancer (Reference 29). OM is an inflammatory disease of the middle ear. OM is often prolonged or antibiotic resistant; these characteristics suggest TLR stimulation in the absence of live bacteria. An abnormal TLR signaling response could lead to exaggerated cell-activation responses contributing to sepsis (Reference 30 and 31).

[0053] Inflammation is also an aspect of autoimmunity, and is hypothesized to play a role in tissue destruction in diseases such as multiple sclerosis, rheumatoid arthritis and insulin-dependent diabetes mellitus (Reference 32). Cells of the innate immune system have an essential role in acquired/adaptive immunity. TLR proteins are involved in the maturation and activation of dendritic cells, the antigen-presenting cell type considered most relevant to development of acquired immunity (Reference 33). Allergic asthma is an example of a chronic inflammatory disease with an adaptive immune response, and the TLR signaling pathway is implicated in the induction phase of an allergic phenotype (Reference 30). Bacterial and viral infections, causing increased inflammatory cell activation, are the main

cause of exacerbations in diseases such as asthma and COPD (chronic obstructive pulmonary disease) (Reference 30).

[0054] In some embodiments, the inflammation is caused by a virus, bacteria, fungi, antigen, self-antigen, or a combination thereof. In some embodiments, the inflammation is associated with a virus, bacteria, fungi, antigen, self-antigen, or a combination thereof. In some embodiments, the inflammation is correlated with a virus, bacteria, fungi, antigen, self-antigen, or a combination thereof. In some embodiments, the inflammation is accompanied by a virus, bacteria, fungi, antigen, self-antigen, or a combination thereof. In some embodiments, an organism having the inflammation also has a virus, bacteria, fungi, antigen, self-antigen, or a combination thereof.

[0055] In some embodiments, the peptides provided herein are administered to a subject for the treatment of inflammation. Non-limiting examples of the causes of inflammation include viral, bacterial or fungal infection. In some embodiments, the inflammation is a result of a response to a self-antigen or any other antigen. In some embodiments, the inflammation is a result of a response to an anti-self-antigen

[0056] In some embodiments, the inflammation comprises inflammation of the ear. The inflammation of the ear can be inflammation of the inner ear and/or middle ear. In some embodiments, the inflammation comprises otitis media. In some embodiments, pharmaceutical compositions of the instant invention are used for the treatment of otitis media.

[0057] C3H/HeJ mice, defective in TLR4 signaling, are known to develop chronic otitis media ("COM") spontaneously. Such mice with inner ear inflammation may show sensorineural hearing loss in addition to middle ear conductive hearing loss. Histologic examination of the middle and inner ear of C3H/HeJ mice with COM has documented a thickening of the mucosal surfaces of the middle ear, thickening of the round window membrane, fibrosis, labyrinthitis, and Eustachian tube obstruction. These histologic changes correlate with the histology seen with human temporal bone from patients with a history of COM and labyrinthitis. The mouse studies have shown that C3H/HeJ mice with COM have gram-negative Klebsiella bacteria in the middle ear. The analogies between the observations in the mouse experiments and those in human COM and labrinthitis patients suggest that mouse experiments with a peptide or pharmaceutical composition of the invention disclosed herein provide results predictive of what the therapeutic effect would be in a human subject.

[0058] In some embodiments, otitis media is associated with hearing loss or reduced hearing. Administration of a peptide of the invention of a pharmaceutical composition thereof can improve the hearing of the affected organism back to ordinary hearing levels. In some embodiments, administration of a therapeutically-effective amount of a pharmaceutical composition to an organism in need or want thereof improves the hearing of the organism, wherein the organism has both otitis media and lessened hearing. In some embodiments, the peptide or pharmaceutical composition is administered topically. In some embodiments, upon administration of a peptide of the invention of a pharmaceutical composition thereof, an organism with hearing loss recovers hearing faster than hearing would be recovered without administration of the peptide or pharmaceutical composition.

[0059] In some embodiments, administration of a therapeutically-effective amount of a peptide of the invention or a pharmaceutical composition comprising the same to an organism with otitis media, wherein the organism is in need or want thereof, provides therapeutic relief of a symptom of otitis media. Non-limiting examples of the symptoms of otitis media include otalgia (pain), otorrhea, fever, irritability, anorexia, vomiting or diarrhea. In some embodiments, the symptom is pain.

[0060] In some embodiments, the inflammation comprises inflammation of the skin, joints, muscular tissue, brain, or connective tissue. In some embodiments, pharmaceutical compositions of the instant invention are used for the treatment of inflammation of the skin, joints, muscular tissue, brain, or connective tissue.

[0061] In some embodiments, the inflammation comprises arthritis, dermatitis, Lupus erythematosus, meningitis, or psoriasis. In some embodiments, the arthritis comprises osteoarthritis, rheumatoid arthritis, septic arthritis, gout, pseudo-gout, juvenile idiopathic arthritis, Still's disease, or ankylosing spondylitis. In some embodiments, the dermatitis comprises spongiotic dermatitis , childhood eczema, allergic contact dermatitis, seborrhoeic dermatitis, dyshidrotic dermatitis, urticaria, vesicular or bullous dermatitis, or papular urticaria. In some embodiments, the psoriasis comprises plaque psoriasis, flexural psoriasis, guttate psoriasis, pustular psoriasis, nail psoriasis, psoriatic arthritis, or erythrodermic psoriasis.

[0062] In some embodiments, the administration comprises topical application. In some embodiments, the administration comprises topical application to the skin, hair, outer ear, tympanic membrane, nasal cavity, buccal cavity, or sublingual cavity.

[0063] In some embodiments, the peptides of the invention and pharmaceutical composition comprising the same are effective for the treatment of sinusitis. In some embodiments, administration of a pharmaceutical composition of the invention to an organism in need or want thereof provides a therapeutic effect on sinusitis or a symptom thereof. Non-limiting examples of symptoms of sinusitis include stuffy or runny nose, nasal discharge, bloody nasal discharge, sneezing, coughing, nasal pain, headache, postnasal drip, itchy face, diminished scent or taste senses, bad breath, fever, chill, dental pain, or face pain. In some embodiments, a pharmaceutical composition of the invention is administered as an aerosol, vapor, spray, or mist.

Therapeutic Uses

[0064] A, "patient," "subject," or "host," to be treated with a pharmaceutical composition of the present invention may mean either a human or non-human animal. In some embodiments, the subject is human. The peptides of the present invention are useful in the treatment of such diseases and disorders such as but not limited to those involving inflammation. In one embodiment, the peptides and pharmaceutical compositions of the present invention may be used in the manufacture of a medicament for any number of uses, including, for example, treating any disease or other treatable condition of a patient.

[0065] A, "therapeutic effect," as the term is used herein, encompasses a therapeutic benefit and/or a prophylactic benefit. By therapeutic benefit is meant eradication or amelioration of the underlying disorder being treated. Also, a therapeutic benefit is achieved with the eradication or amelioration of one or more of the physiological symptoms associated with the underlying disorder such that an improvement is observed in the patient, notwithstanding that the patient may still be afflicted with the underlying disorder. For prophylactic benefit, the compositions may be administered to a patient at risk of developing a particular disease, or to a patient reporting one or more of the physiological symptoms of a disease, even though a diagnosis of this disease may not have been made. A prophylactic effect includes delaying or eliminating the appearance of a disease or condition, delaying or eliminating the onset of symptoms of a disease or condition, slowing, halting, or reversing the progression of a disease or condition, or any combination thereof.

Administration

[0066] A pharmaceutical composition containing a peptide can be administered to patients along with pharmaceutical excipients or diluents. Non-limiting examples of suitable

pharmaceutical excipients or diluents include starch, glucose, lactose, sucrose, gelatin, malt, rice, flour, chalk, silica gel, magnesium carbonate, magnesium stearate, sodium stearate, glycerol monostearate, talc, sodium chloride, dried skim milk, glycerol, propylene, glycol, water, ethanol, buffered water, phosphate buffered saline and the like. These compositions can take the form of drops, solutions, suspensions, tablets, pills, capsules, powders, sustained-release formulations and the like. In some embodiments, the composition is an ear drop. In another preferred embodiment the composition containing a peptide in any form could be further modulated using suitable excipients and diluents including lactose, dextrose, sucrose, sorbitol, mannitol, starches, gum acacia, calcium phosphate, alginates, tragacanth, gelatin, calcium silicate, microcrystalline cellulose, polyvinylpyrrolidone, cellulose, water syrup, methyl cellulose, methyl and propylhydroxybenzoates, talc, magnesium stearate and mineral oil. The formulations can additionally include lubricating agents, wetting agents, emulsifying and suspending agents, preserving agents, sweetening agents or flavoring agents. The compositions can be formulated in a unit dosage form, each dosage containing, for example, from about 1ng to 1000 mg of the peptide. In some embodiments, a dose contains from 100-1000 mg of the peptide. In some embodiments, a dose contains from 100-500 mg of the peptide. In some embodiments, a dose contains from 200-300 mg of the peptide The term, "unit dosage form," refers to physically discrete units suitable as unitary dosages for human subjects and other mammals, each unit containing a predetermined quantity of active material calculated to produce the desired therapeutic effect, in association with a suitable pharmaceutical diluents or excipients. These may be administered to humans, domestic pets, livestock, or other animals with a pharmaceutically-acceptable diluents or excipients, in unit dosage form. Administration may be topical, intraaural, parenteral, intravenous, intra-arterial, subcutaneous, intramuscular, intracranial, intraorbital, ophthalmic, intraventricular, intracapsular, intraspinal, intracisternal, intraperitoneal, intranasal, aerosol, by suppositories, or oral administration. Formulations for oral use include tablets containing the active ingredient(s) in a mixture with non-toxic pharmaceutically-acceptable excipients. These excipients may be, for example, inert diluents or fillers (e.g., sucrose and sorbitol), lubricating agents, glidants, and antiadhesives (e.g., magnesium stearate, zinc stearate, stearic acid, silicas, hydrogenated vegetable oils, or talc).

[0067] The active therapeutic formulation of the invention can be provided in lyophilized form for reconstituting, for instance, in isotonic, aqueous, or saline buffers for parental, subcutaneous, intradermal, intramuscular or intravenous administration. The subject

composition of the invention may also be administered to the patient in need of a therapeutic peptide by liquid preparations for orifice, e.g. oral, intraaural, nasal, or sublingual, administration such as suspensions, syrups or elixirs. The subject composition of the invention may also be prepared for oral administration such as capsules, tablets, pills, and the like, as well as chewable solid formulations. The subject composition of the invention may also be prepared as a cream for dermal administration such as liquid, viscous liquid, paste, or powder. The subject composition of the invention may also be prepared as powder for lung administration with or without aerosolizing component. The composition of the invention can be prepared as a drop, for example, an ear drop.

[0068] The presently disclosed compositions can be used for delivery in oral, intraaural, intranasal, sublingual, intraduodenal, subcutaneous, buccal, intracolonic, rectal, vaginal, mucosal, pulmonary, transdermal, intradermal, parenteral, intravenous, intramuscular and ocular forms as well as being able to traverse the blood-brain barrier.

Dosages

[0069] The dosage of any peptide of the present invention will vary depending on the symptoms, age and body weight of the patient, the nature and severity of the disorder to be treated or prevented, the route of administration, and the form of the composition. Any of the subject formulations may be administered in a single dose or in divided doses. Dosages for the peptides of the present invention may be readily determined by techniques known to those of skill in the art or as taught herein. Also, the present invention contemplates mixtures of more than one subject peptide, as well as other therapeutic agents.

[0070] In certain embodiments, the dosage of the subject peptide will generally be in the range of about 0.01 ng to about 10 g per kg body weight, specifically in the range of about 1 ng to about 0.1 g per kg, and more specifically in the range of about 100 ng to about 10 mg per kg.

[0071] An effective dose or amount, and any possible affects on the timing of administration of the formulation, may need to be identified for any particular peptide of the present invention. This may be accomplished by routine experiment as described herein, using one or more groups of animals, or in human trials if appropriate. The effectiveness of any peptide and method of treatment or prevention may be assessed by administering the supplement and assessing the effect of the administration by measuring one or more indices associated with the neoplasm of interest, and comparing the post-treatment values of these indices to the values of the same indices prior to treatment.

[0072] The precise time of administration and amount of any particular peptide that will yield the most effective treatment in a given patient will depend upon the activity, pharmacokinetics, and bioavailability of a particular peptide, physiological condition of the patient (including age, sex, disease type and stage, general physical condition, responsiveness to a given dosage and type of medication), route of administration, and the like. The guidelines presented herein may be used to optimize the treatment, e.g., determining the optimum time and/or amount of administration, which will require no more than routine experimentation consisting of monitoring the subject and adjusting the dosage and/or timing.

[0073] While the subject is being treated, the health of the subject may be monitored by measuring one or more of the relevant indices at predetermined times during a 24-hour period. Treatment, including supplement, amounts, times of administration and formulation, may be optimized according to the results of such monitoring. The patient may be periodically reevaluated to determine the extent of improvement by measuring the same parameters, the first such reevaluation typically occurring at the end of four weeks from the onset of therapy, and subsequent reevaluations occurring every four to eight weeks during therapy and then every three months thereafter. Therapy may continue for several months or even years, with a minimum of one month being a typical length of therapy for humans. Adjustments to the amount(s) of peptide administered and possibly to the time of administration may be made based on these reevaluations.

[0074] Treatment may be initiated with smaller dosages which are less than the optimum dose of the peptide. Thereafter, the dosage may be increased by small increments until the optimum therapeutic effect is attained.

[0075] The combined use of several peptides of the present invention, or alternatively other peptides, may reduce the required dosage for any individual component because the onset and duration of effect of the different components may be complimentary. In such combined therapy, the different peptides may be delivered together or separately, and simultaneously or at different times within the day.

[0076] Toxicity and therapeutic efficacy of subject peptides may be determined by standard pharmaceutical procedures in cell cultures or experimental animals, e.g., for determining the LD_{50} and the ED_{50}. Although peptides that exhibit toxic side effects may be used, care should be taken to design a delivery system that targets the peptides to the desired site in order to reduce side effects.

[0077] The data obtained from cell culture assays and animal studies may be used in formulating a range of dosage for use in humans. The dosage of any supplement, or alternatively of any components therein, lies preferably within a range of circulating concentrations that include the ED_{50}, with little or no toxicity. The dosage may vary within this range depending upon the dosage form employed and the route of administration utilized. For peptides of the present invention, the therapeutically effective dose may be estimated initially from cell culture assays. A dose may be formulated in animal models to achieve a circulating plasma concentration range that includes the IC_{50} (i.e., the concentration of the test peptide which achieves a half-maximal inhibition of symptoms) as determined in cell culture. Such information may be used to more accurately determine useful doses in humans. Levels in plasma may be measured, for example, by high performance liquid chromatography (HPLC).

Formulations

[0078] The peptide-based compositions of the present invention may be administered by various means, depending on their intended use, as is well known in the art. For example, if compositions of the present invention are to be administered orally, they may be formulated as tablets, capsules, granules, powders or syrups. Alternatively, formulations of the present invention may be administered parenterally as injections (intravenous, intramuscular or subcutaneous), drop infusion preparations or suppositories. The peptide-based compositions can also be administered into deep lung by aerosolizing the composition into 1-5 um particle using standard techniques known in the art either with or without addition of aerosolizing excipient. For application by the ophthalmic mucous membrane route, compositions of the present invention may be formulated as eye drops or eye ointments. Aural pharmaceutical compositions can be formulated as ear drops, ointments, creams, liquids, gels, or salves for application to the ear, either internally or superficially. These formulations may be prepared by conventional means, and, if desired, the compositions may be mixed with any conventional additive, such as an excipient, a binder, a disintegrating agent, a lubricant, a solubilizing agent, a suspension aid, an emulsifying agent or a coating agent.

[0079] In formulations of the subject invention, wetting agents, emulsifiers and lubricants, such as sodium lauryl sulfate and magnesium stearate, as well as coloring agents, release agents, coating agents, sweetening, flavoring and perfuming agents, preservatives and antioxidants may be present in the formulated agents.

[0080] Subject peptide-based compositions may be suitable for oral, intraaural, nasal, topical (including buccal and sublingual), rectal, vaginal, aerosol and/or parenteral administration. The formulations of the peptide-based compositions may conveniently be presented in unit dosage form and may be prepared by any methods well known in the art of pharmacy. The amounts of composition that may be combined with other excipients to produce a single dose may vary depending upon the subject being treated, and the particular mode of administration.

[0081] Formulations suitable for oral administration may be in the form of capsules, cachets, pills, tablets, lozenges (using a flavored basis, usually sucrose and acacia or tragacanth), powders, granules, or as a solution or a suspension in an aqueous or non-aqueous liquid, or as an oil-in-water or water-in-oil liquid emulsion, or as an elixir or syrup, or as pastilles (using an inert base, such as gelatin and glycerin, or sucrose and acacia), each containing a predetermined amount of a subject composition thereof as an active ingredient. Compositions of the present invention may also be administered as a bolus, electuary, or paste.

[0082] In solid dosage forms for oral administration (capsules, tablets, pills, dragees, powders, granules and the like), the subject peptide composition is mixed with one or more pharmaceutically-acceptable carriers, such as sodium citrate or dicalcium phosphate, and/or any of the following: (1) fillers or extenders, such as starches, lactose, sucrose, glucose, mannitol, and/or silicic acid; (2) binders, such as, for example, carboxymethyl cellulose, alginates, gelatin, polyvinyl pyrrolidone, sucrose and/or acacia; (3) humectants, such as glycerol; (4) disintegrating agents, such as agar-agar, calcium carbonate, potato or tapioca starch, alginic acid, certain silicates, and sodium carbonate; (5) solution retarding agents, such as paraffin; (6) absorption accelerators, such as quaternary ammonium compounds; (7) wetting agents, such as, for example, acetyl alcohol and glycerol monostearate; (8) absorbents, such as kaolin and bentonite clay; (9) lubricants, such a talc, calcium stearate, magnesium stearate, solid polyethylene glycols, sodium lauryl sulfate, and mixtures thereof; and (10) coloring agents. In the case of capsules, tablets and pills, the peptide compositions may also comprise buffering agents. Solid compositions of a similar type may also be employed as fillers in soft and hard-filled gelatin capsules using such excipients as lactose or milk sugars, as well as high molecular weight polyethylene glycols and the like.

[0083] A tablet may be made by compression or molding, optionally with one or more accessory ingredients. Compressed tablets may be prepared using binder (for example,

gelatin or hydroxypropylmethyl cellulose), lubricant, inert diluent, preservative, disintegrant (for example, sodium starch glycolate or cross-linked sodium carboxymethyl cellulose), surface-active or dispersing agent. Molded tablets may be made by molding in a suitable machine a mixture of the subject composition moistened with an inert liquid diluent. Tablets, and other solid dosage forms, such as dragees, capsules, pills and granules, may optionally be scored or prepared with coatings and shells, such as enteric coatings and other coatings well known in the pharmaceutical-formulating art.

[0084] Liquid dosage forms for oral administration include pharmaceutically-acceptable emulsions, microemulsions, gels, solutions, suspensions, syrups and elixirs. The liquid dosage peptide formulation may contain inert diluents commonly used in the art, such as, for example, water or other solvents, solubilizing agents and emulsifiers, such as ethyl alcohol, isopropyl alcohol, ethyl carbonate, ethyl acetate, benzyl alcohol, benzyl benzoate, propylene glycol, 1,3-butylene glycol, oils (in particular, cottonseed, groundnut, corn, germ, olive, castor and sesame oils), glycerol, tetrahydrofuryl alcohol, polyethylene glycols and fatty acid esters of sorbitan, and mixtures thereof.

[0085] Suspension dosage of the peptide formulation may contain suspending agents as, for example, ethoxylated isostearyl alcohols, polyoxyethylene sorbitol and sorbitan esters, microcrystalline cellulose, aluminum metahydroxide, bentonite, agar-agar and tragacanth, and mixtures thereof.

[0086] The peptide formulations for rectal or vaginal administration may be presented as a suppository, which may be prepared by mixing a peptide with one or more suitable carriers and other excipients comprising, for example, cocoa butter, polyethylene glycol, a suppository wax or a salicylate, and which is solid at room temperature, but liquid at body temperature and, therefore, will melt in the body cavity and release peptide. Formulations which are suitable for vaginal administration also include pessaries, tampons, creams, gels, pastes, foams or spray formulations containing excipients as are known in the art to be appropriate.

[0087] The peptide dosage formulations for transdermal administration of a subject composition includes drops, powders, sprays, ointments, pastes, creams, lotions, gels, solutions, patches and inhalants. The active component may be mixed under sterile conditions with a pharmaceutically-acceptable carrier, and with any preservatives, buffers, or propellants which may be required.

[0088] The ointments, pastes, creams and gels may contain, in addition to a subject composition, excipients, such as animal and vegetable fats, oils, waxes, paraffin, starch, tragacanth, cellulose derivatives, polyethylene glycols, silicones, bentonite, silicic acid, talc and zinc oxide, or mixtures thereof. The peptide compositions of the present invention may also be in the form of baby wipes.

[0089] Powders and sprays may contain, in addition to a subject composition, excipients such as lactose, talc, silicic acid, aluminum hydroxide, calcium silicates and polyamide powder, or mixtures of these substances. Sprays may additionally contain customary propellants, such as chlorofluorohydrocarbons and volatile unsubstituted hydrocarbons, such as butane and propane.

[0090] The peptide compositions of the present invention may alternatively be administered by aerosol. This is accomplished by preparing an aqueous aerosol, liposomal preparation or solid particles containing the compound. A non-aqueous (e.g., fluorocarbon propellant) suspension could be used. Sonic nebulizers may be used because they minimize exposing the peptide to shear, which may result in degradation of the peptides contained in the subject compositions.

[0091] Ordinarily, an aqueous aerosol is made by formulating an aqueous solution or suspension of a subject composition together with conventional pharmaceutically-acceptable carriers and stabilizers. The carriers and stabilizers vary with the requirements of the particular subject composition, but typically include non-ionic surfactants (Tweens, Pluronics, or polyethylene glycol), innocuous proteins like serum albumin, sorbitan esters, oleic acid, lecithin, amino acids such as glycine, buffers, salts, sugars or sugar alcohols. Aerosols generally are prepared from isotonic solutions.

[0092] Pharmaceutical compositions of this invention suitable for parenteral administration comprise a subject composition in combination with one or more pharmaceutically-acceptable sterile isotonic aqueous or non-aqueous solutions, dispersions, suspensions or emulsions, or sterile powders which may be reconstituted into sterile injectable solutions or dispersions just prior to use, which may contain antioxidants, buffers, bacteriostats, solutes which render the formulation isotonic with the blood of the intended recipient or suspending or thickening agents.

[0093] Examples of suitable aqueous and non-aqueous carriers which may be employed in the pharmaceutical compositions of the invention include water, ethanol, polyols (such as glycerol, propylene glycol, polyethylene glycol, and the like), and suitable mixtures thereof,

vegetable oils, such as olive oil, and injectable organic esters, such as ethyl oleate. Proper fluidity may be maintained, for example, by the use of coating materials, such as lecithin, by the maintenance of the required particle size in the case of dispersions, and by the use of surfactants.

EXAMPLES

EXAMPLE 1: Materials and Methods

[0094] *Peptide of the natural configuration*: Peptides were synthesized by Mimotopes using their unique proprietary parallel array synthesis platform. Each peptide contains an amino acid sequence of the invention and optionally a 9-residue arginine cell transduction sequence positioned at the C-terminus of the peptide to facilitate cellular uptake. The peptides are presented in Table 1.

[0095] *Peptides with D-amino acid residues are synthesized as peptides with L-amino acid residues are synthesized.* The D-amino acids with the appropriate protecting groups are commercially available for use on automated systems to construct peptides. Peptides described herein can be made entirely from L-amino acids, entirely from D-amino acids, or from a mixture of both in any proportion. A peptide is considered stereochemically-mixed if the peptide comprises at least one L-, and at least one D-amino acid residue. The transduction tag can similarly be made entirely from L-amino acids, entirely from D-amino acids, or from a mixture of both in any proportion. Peptides differing only in stereochemistry may possess differing properties, benefits, specificities, affinities, and activities at the same or at different receptors. In some cases, peptides differing only in stereochemistry may exhibit comparable specificities and activities.

[0096] Each peptide is constructed both with and without a FITC-label (Fluorescein isothiocyanate). FITC labeled peptides are used for FACS analysis. The peptides lacking the FITC label are used for *in vitro* inhibition assays and *in vivo* treatment studies.

[0097] *Reagents*: Nuclease-resistant phosphorylated oligonucleotide was purchased from Oligos Etc., Inc. The sequence was 5'-TCCATGACGTTCCTGACGTT-3' (SEQ ID NO: 377) (CpG-oligodeoxynucleotide (ODN). TNF-α assays were performed using assay kits purchased from R&D Systems. Mouse IL-1α and TNF-α were purchased from R&D Systems. PMA (phorbol myristate acetate) and LPS (Lipopolysaccaride) were purchased from Sigma. The TLR ligands flagellin, zymosan, and Poly (I:C) were purchased from Invivogen. Cytokine assays were performed using assay kits purchased from R&D Systems.

(Heat-inactivated *S. pneumoniae* was the kind gift of Dr. Thomas DeMaria, The Ohio State University College of Medicine, Department of Otolaryngology, Columbus, Ohio.)

[0098] *Cell lines and cultures*: RAW264.7 (murine monocyte/macrophage cells (American Type Culture Collection) were cultured at 37 °C in a 5% CO_2 humidified incubator and grown in DMEM (Invitrogen Life Technologies) supplemented with 10% (v/v) heat-inactivated FCS, 1.5 mM L-glutamine, 100 U/ml penicillin, and 100 µg/ml streptomycin.

[0099] *Cytokine secretion*: RAW264.7 cells were plated at 1.5×10^5 cells/well - 3×10^5 cells/well in 48-well plates. After 24 hours, the cells were incubated with peptides at various concentrations at room temperature in triplicate either before, simultaneous with, or after activation with various PAMPs for 18 hours. Cell-free supernatants were analyzed for cytokines by ELISA, in quadruplicate. RAW264.7 cells were stimulated with either CpG-ODN (1 µg/ml or 1.25 µg/ml), LPS (about 1 ng/ml), Poly (I:C) (about 10 µg/ml), flagellin (about 5 ng/ml), or zymosan (about 10 µg/ml). Dose response curves were done with each PAMP to determine optimal stimulation concentration. For CpG-ODN stimulation, cells were incubated for 4 hours at 37 °C, supernatants collected, and TNF-α measured by ELISA. Any cytokine involved in inflammatory disease mediated toll receptor signaling can be measured using similar assays.

[0100] *Flow Cytometry*: Cells are analyzed by flow cytometry (FACScan, Becton Dickinson) using Cellquest software to quantify internalization of peptides. Gates are drawn to exclude dead cells based on 7-AAD (7-amino-actinomycin D) staining. Flourescence due to cell-surface binding of FITC-labeled peptides is quenched using trypan blue. Data obtained are geometric mean fluorescent units (F) with background autofluorescence subtracted.

[0101] *Immunoblotting*: RAW264.7 cells (6×10^5) are plated in 12 well plates overnight. Cells are incubated for 15 minutes at room temperature with peptides to be tested or control scrambled peptides, and then stimulated with medium or LPS (1 ng/ml) for either 15 or 30 minutes. Cells are lysed, and proteins fractionated by SDS/PAGE (Sodium Dodecyl Sulfate/Polyacrylamide Gel Electrophoresis) (12%). Immunoblotting is done using Phospho-IkB-α (Ser32) antibody (Cell Signaling), detected using horseradish peroxidase-conjugated secondary antibody, and visualized by chemiluminescence. Measurements of band intensity are made using the Nucleo Tech Gel Expert software linked to an Epson expression 636 scanner and expressed as intensity/area.

[0102] *Cell viability*: Cells were assayed for viability using CellTiter 96 Aq_{ueous} One Solution Cell Proliferation Assay (Promega) following manufacturer's instructions. Briefly, cells were

seeded in 96 well plates and incubated overnight at 37 °C in a humidified 5% CO_2 atmosphere. When samples were ready to be assayed, 20 µl of reagent was added into each well, and incubated for 1.5 hrs at 37 °C in a humidified 5% CO_2 atmosphere. Absorbances were read at 490 nm using an ELx800 absorbance microplate reader (BioTek) and data analyzed with Gen5 software (BioTek). Some peptides were evaluated for their effect on cell viability by trypan blue exclusion staining over a range of concentrations and then each peptide was tested for cytokine inhibition at the maximum concentration that had no effect on cell viability.

EXAMPLE 2: Effect of Peptides on CpG-ODN-Induced Cytokine Secretion

[0103] The effect of several peptides on TNF-α secretion from RAW264.7 cells in response to stimulation by CpG-ODN was studied. Each peptide was initially tested at 3 concentrations, 37 µM, 22.2 µM, and 11.1 µM. Seventeen peptides demonstrating inhibition of TNF-α secretion of 50-100% across all three doses are presented (Table 2). The peptides were then tested at 11.1 µM, 7.4 µM, and 3.7 µM (Table 3). The peptides continued to demonstrate inhibitory activity at 7.4 µM, and twelve of the peptides had inhibitory activity at 3.7 µM. Cell viability was examined for each peptide at the concentrations tested for TNF-α inhibition. No decrease in cell viability was demonstrated.

Table 2. Percent Inhibition of TNF-α secretion by S1-S22 peptides with a R^9 sequence. RAW264.7 cells were plated at $3X10^5$ cells/well in 48-well plates. After 24 h the cells were incubated with peptide at various concentrations at room temperature in triplicate for 15 minutes and then stimulated with 1 ug/ml Cpg-ODN. Cells were then incubated for 4 hours at 37 °C, supernatants collected, and TNF-α measured by ELISA. Percent inhibition was calculated by comparing TNF-α secretion from cells incubated with peptide to control cells with no peptide treatment.

Peptide	**37 µM**	**22.2 µM**	**11.1 µM**	**Sequence**
42 (S1) - R^9	97	96	85	EMFTILEEYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 42)
43 (S2) - R^9	100	94	91	MFTILEEYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 43)
44 (S3) - R^9	95	96	91	FTILEEYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 44)

68 (S4) - R^9	100	100	95	EMFTILEEYFMYRGLLGLRIKYGRLFNRRRRRRRRR (SEQ ID NO: 68)
69 (S5) - R^9	100	100	93	EMFTILEEYFMYRGLLGLRIKYGRLFRRRRRRRRR (SEQ ID NO: 69)
70 (S6) - R^9	100	100	93	EMFTILEEYFMYRGLLGLRIKYGRLRRRRRRRRR (SEQ ID NO: 70)
71 (S7) - R^9	91	82	56	EMFTILEEYFMYRGLLGLRIKYGRRRRRRRRRRR (SEQ ID NO: 71)
72 (S8) - R^9	100	100	92	EMFTILEEYFMYRGLLGLRIKYGRRRRRRRRRR (SEQ ID NO: 72)
73 (S9) - R^9	100	100	84	EMFTILEEYFMYRGLLGLRIKYRRRRRRRRRR (SEQ ID NO: 73)
74 (S10) -R^9	100	100	91	EMFTILEEYFMYRGLLGLRIKRRRRRRRRRR (SEQ ID NO: 74)
75 (S11) -R^9	98	97	92	EMFTILEEYFMYRGLLGLRIRRRRRRRRRR (SEQ ID NO: 75)
76 (S12) -R^9	87	84	82	EMFTILEEYFMYRGLLGLRRRRRRRRRRR (SEQ ID NO: 76)
77 (S13) -R^9	93	89	84	EMFTILEEYFMYRGLLGLRRRRRRRRRR (SEQ ID NO: 77)
79 (S14) -R^9	97	93	85	EMFTILEEYFMYRGLLRRRRRRRRRR (SEQ ID NO: 79)
80 (S15) -R^9	91	87	78	EMFTILEEYFMYRGLRRRRRRRRRR (SEQ ID NO: 80)
81 (S16) -R^9	90	86	84	EMFTILEEYFMYRGRRRRRRRRRR (SEQ ID NO: 81)
83 (S17) -R^9	89	82	72	EMFTILEEYFMYRRRRRRRRRR (SEQ ID NO: 83)
102 (S18) -R^9	—	91	72	MFTILEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 102)
103 (S19) -R^9	—	99	93	FTILEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 103)

104 (S20) -R^9	—	93	74	TILEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 104)
105 (S21) -R^9	—	91	62	ILEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 105)
106 (S22) -R^9	—	92	70	LEEYFMYGLLGLRIRRRRRRRRR (SEQ ID NO: 106)

Table 3. Inhibition of TNF-α secretion by S1-S22 peptides with an R^9 sequence. RAW264.7 cells were plated at $3X10^5$ cells/well in 48-well plates. After 24 h the cells were incubated with peptide at various concentrations at room temperature in triplicate for 15 minutes and then stimulated with 1 ug/ml Cpg-ODN. Cells were then incubated for 4 hours at 37 °C, supernatants collected, and TNF-α measured by ELISA. Percent inhibition was calculated by comparing TNF-α secretion from cells incubated with peptide to control cells with no peptide treatment.

Peptide	**11 μM**	**7 μM**	**3.1 μM**	**Sequence**
42 (S1) -R^9	83	67	37	EMFTILEEYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 42)
43 (S2) -R^9	70	51	0	MFTILEEYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 43)
44 (S3) -R^9	78	24	0	FTILEEYFMYRGLLGLRIKYGRLFNEIRRRRRRRRR (SEQ ID NO: 44)
68 (S4) -R^9	95	83	69	EMFTILEEYFMYRGLLGLRIKYGRLFNRRRRRRRRR (SEQ ID NO: 68)
69 (S5) -R^9	93	94	66	EMFTILEEYFMYRGLLGLRIKYGRLFRRRRRRRRR (SEQ ID NO: 69)
70 (S6) -R^9	94	87	63	EMFTILEEYFMYRGLLGLRIKYGRLRRRRRRRRR (SEQ ID NO: 70)
71 (S7) -R^9	38	29	21	EMFTILEEYFMYRGLLGLRIKYGRRRRRRRRRRR (SEQ ID NO: 71)
72 (S8) -R^9	93	80	43	EMFTILEEYFMYRGLLGLRIKYGRRRRRRRRRR (SEQ ID NO: 72)
73 (S9) -R^9	85	76	3	EMFTILEEYFMYRGLLGLRIKYRRRRRRRRRR (SEQ ID NO: 73)

74 (S10) - R^9	92	80	35	EMFTILEEYFMYRGLLGLRIKRRRRRRRRR (SEQ ID NO: 74)
75 (S11) - R^9	93	84	31	EMFTILEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 75)
76 (S12) - R^9	84	67	44	EMFTILEEYFMYRGLLGLRRRRRRRRRR (SEQ ID NO: 76)
77 (S13) - R^9	81	77	18	EMFTILEEYFMYRGLLGLRRRRRRRRR (SEQ ID NO: 77)
79 (S14) - R^9	86	77	0	EMFTILEEYFMYRGLLRRRRRRRRR (SEQ ID NO: 79)
80 (S15) - R^9	81	68	57	EMFTILEEYFMYRGLRRRRRRRRR (SEQ ID NO: 80)
81 (S16) - R^9	70	53	26	EMFTILEEYFMYRGRRRRRRRRR (SEQ ID NO: 81)
83 (S17) - R^9	57	44	0	EMFTILEEYFMYRRRRRRRRR (SEQ ID NO: 83)
102 (S18) - R^9	72	48	—	MFTILEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 102)
103 (S19) - R^9	93	87	—	FTILEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 103)
104 (S20) - R^9	74	60	—	TILEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 104)
105 (S21) - R^9	62	52	—	ILEEYFMYRGLLGLRIRRRRRRRRR (SEQ ID NO: 105)
106 (S22) - R^9	70	53	—	LEEYFMYGLLGLRIRRRRRRRRR (SEQ ID NO: 106)

EXAMPLE 3: Effect of Peptides on of CpG-ODN-Induced Cytokine Secretion

[0104] Inhibition of TNF-α secretion by various T-peptides was examined. RAW264.7 cells were plated at $3X10^5$ cells/well in 48-well plates. After 24 h the cells were incubated with peptide at various concentrations at room temperature in triplicate for 15 minutes and then stimulated with 1.25 ug/ml CpG-ODN or 1 ng/ml LPS. Cells were then incubated for 4 hours at 37 °C, supernatants collected, and TNF-α measured by ELISA. Percent inhibition was

calculated by comparing TNF-α secretion from cells incubated with peptide to control cells with no peptide treatment. The inhibition by peptides T3, T11, T21, T36, T37, T51 and T52 were compared to inhibition by an analogue of P13 having a sequence of nine arginine residues at the C-terminus (P13-R^9). (Table 4).

Table 4. Percent Inhibition of TNF-α secretion by T peptides. Percent inhibition was calculated by comparing TNF-α secretion from cells incubated with peptide to control cells with no peptide treatment.

Peptide	**22 μM**	**11.1 μM**	**7.1 μM**	**Sequence**
CpG stimulation				
P13-R^9	86	65	32	DIVKLTVYDCIRRRRRRRRR (SEQ ID NO: 378)
T3-R^9	99	92	85	AIVKLTVYDCIRRRRRRRRR (SEQ ID NO: 133)
T21-R^9	98	90	69	DIVKLYVYDCIRRRRRRRRR (SEQ ID NO: 151)
T36-R^9	82	70	50	DIIKLTVYDCIRRRRRRRRR (SEQ ID NO: 166)
T37-R^9	93	87	46	DIVKVTVYDCIRRRRRRRRR (SEQ ID NO: 167)
T51-R^9	99.7	98	94	AIVKLTVYACIRRRRRRRRR (SEQ ID NO: 181)
T52-R^9	100	99.2	97.8	AIIKVYVYACIRRRRRRRRR (SEQ ID NO: 182)
LPS Stimulation				
Peptide	**22.2 uM**	**11.1 uM**	**7.4 uM**	**Sequence**
P13-R^9	69	13	0	DIVKLTVYDCIRRRRRRRRR (SEQ ID NO: 378)
T3-R^9	77	65	33	AIVKLTVYDCIRRRRRRRRR (SEQ ID NO: 133)
T11-R^9	91	81	68	DIVKLTVYACIRRRRRRRRR (SEQ ID NO: 141)

EXAMPLE 4: Structure-activity testing of peptides derived from P13

[0105] Structure-activity relationships (SAR) were investigated to determine tolerances to residue modification in P13. Peptides used in the SAR include SEQ ID NOS: 131-182, used to study the activities of SEQ ID NOS: 317-368. Peptides possessing the following structural modifications were made and evaluated for activity vis-à-vis P13:

1. Deletions of N- and/or C-terminal residues;
2. Alanine scan at each residue;
3. Comparison of residues with like charges at the same position (for example, Asp or Glu at the same position; Lys, Arg, or His at the same position) ;

4. Comparison of hydroxylated side chains at the same position (for example, Ser or Thr at the same position);
5. Comparison of aromatic side chains at the same position (for example, Phe, Tyr, His, or Trp at the same position);
6. Replacement of side chains with sulfur-containing side chains (for example, Met and Cys);
7. Conservative replacement of branched aliphatic side chains (for example, Leu, Ile, and Val);
8. Disruption of structure by inclusion of alternate residues;
9. Reverse and scrambled sequence; and
10. Dimerization.

[0106] The SAR revealed that certain substitutions led to peptides with activity superior to that of P13. The substitution of a single amino acid, in at least five different cases, and the substitution of two or more amino acids in at least two cases, resulted in superior activity. These seven peptides are SEQ ID NOS: 133, 141, 151, 166, 167, 181, and 182. The discovery was unexpected in that the activity of the SAR derivatives was expected to be comparable or lesser than that of P13. Activity was defined as inhibition of TNF-α after stimulation of RAW264.7 cells with CpG.

EXAMPLE 5: Effect of Peptides on Otitis Media

[0107] *Induction of otitis media*: BALB/c (Bagg albino) mice, about 8–12 weeks of age, are anesthetized with a subcutaneous injection of xylazine & ketamine (about 0.1 mg/30 gm body weight) and their ears examined under the operating microscope to assure they are free of infection or perforation. One group of animals is injected with PBS (Phospho-buffered saline) in one ear and with about 10 μM of a peptide of Table 1 in the opposite ear, to determine the effect of peptide without added bacteria. A second group of animals receive about 5.0 μl of PBS plus heat-inactivated *S. pneumoniae* (about 10^9 CFU/ml) in one ear and about 5.0 μl of peptide (about 10 μM) plus heat-inactivated *S. pneumoniae* (about 10^9 CFU/ml) in the opposite ear. Injections are done through the tympanic membrane. Animals are killed about 3 days after bacterial injection and tissue is histologically processed to assess middle ear disease. Inflammation is quantified by measuring 1) area of fluid present in the middle ear; 2) number of cells in middle ear fluid; and 3) thickness of the tympanic membrane (TM) taken at a point away from the injection site. Data are obtained from mice (n=18) injected with PBS alone for each of the histological parameters measured, to serve as a control group. Disease induction is defined as positive if the ear injected with *S. pneumoniae* without peptide demonstrated an increase of at least two standard deviations

above the control PBS treated mice in at least two of the three parameters assessed for middle ear inflammation: Fluid area, cell number, thickness of the tympanic membrane.

[0108] *Tissue Collection*: At the end of the experimental treatment, mice are killed and tissues collected for histology. Mice are overdosed on anesthetic and perfused intracardially with about 1.0 ml of saline, followed by about 20 ml of fixative (about 1.5% paraformaldehyde, about 3% glutaraldehyde in about 0.1 M phosphate buffer). The middle ears are left intact and connected to each other by the skull base so both ears are processed together for histology and sectioning. This enables all histologic embedding, sectioning, staining, and analysis to be done on the two sides simultaneously to reduce any impact of processing variables on the subsequent quantitative analyses. Middle ears are decalcified, embedded in glycol methacrylate plastic, sectioned at about 5 μm, mounted serially on glass slides, stained, and coverslipped.

[0109] *Histopathologic Analysis*: Three consecutive sections at the level of the umbo and promontory are selected for measures of 1) area of fluid present in the middle ear; 2) number of cells in middle ear fluid; and 3) thickness of the tympanic membrane. Each measurement is taken on the three sequential sections per specimen.

[0110] *Statistical analyses*: To determine the effect of peptide without added bacteria, animals are injected in one ear with PBS alone, and the other ear with about 10 μM peptide. Paired t-tests are done comparing the effect of PBS alone with the effect of peptide for each of the three histological parameters: 1) area of fluid present in the middle ear; 2) number of cells in middle ear fluid; and 3) thickness of the tympanic membrane. Paired t-tests are done using these animals comparing the effect of peptide plus *S. pneumoniae* in one ear with *S. pneumoniae* alone in the opposite ear for each of the histological parameters described above.

EXAMPLE 6: Effect of Peptides on Septic Shock

[0111] *Inhibition of inflammatory mediators in a murine septic shock model*. BALB/c mice are injected i.p. with PBS, LPS at about 100 μg/mouse/250 μl, or about 100 μg LPS plus various doses of peptides. Serum is collected at about 2 and about 6 hours after treatment and evaluated for the pro-inflammatory cytokines MIP-2 and TNF-α by ELISA, and for soluble ICAM-1.

EXAMPLE 7: Effects of P13 on Mouse Middle Ear

Assay of effects caused by peptide without added bacteria.

[0112] Five mice were injected in one ear with PBS and in the opposite ear with 10 μM peptide P13. Three days later the animals were killed, and the middle ears embedded, sectioned, stained and evaluated for fluid area, infiltrating cell number, and thickness of the tympanic membrane. Paired t-tests (2-tailed) were used to analyze each of the three parameters. In the absence of bacterial-induced inflammation, no differences were seen between the PBS-injected ear and P13-injected ear in 1) fluid area (p=0.104); 2) cell number (p=0.880); or 3) tympanic membrane thickness (p=0.891).

Assay of effects caused by peptide with added bacteria.

[0113] To examine the effectiveness of the peptide to affect inflammation in vivo, twenty BALB/c mice were injected in the middle ear on one side with heat-inactivated S. pneumoniae plus PBS, and in the middle ear on the opposite side with heat-inactivated S. pneumoniae plus 10 μM peptide P13. Three days later the animals were killed, and evaluated for middle ear fluid area, infiltrating cell number, and thickness of the tympanic membrane. Disease development was defined as an increase over background controls (PBS injected ears n=18) of at least two standard deviations in two out of the three parameters quantified. A total of 7 out of 20 mice met the criteria for disease induction. Analysis of middle ears by paired t-tests from these 7 mice with disease showed that peptide treatment significantly reduced the amount of fluid (p=0.004), infiltrating cell number (p=0.02), and thickness of the tympanic membrane (p=0.002). Examination of these three parameters of inflammation for each individual mouse with disease illustrated the dramatic effect seen with a single treatment of peptide P13. Of interest, 6 of the 7 mice demonstrated reductions in all areas of inflammation, while one animal showed only modest reduction in fluid area and tympanic membrane thickness, and no reduction in cell number. Injection of heat-killed bacteria resulted in a marked inflammatory response in the middle ear after 3 days. This was characterized by mucosal and tympanic membrane swelling, cellular infiltration, and significant fluid (effusion) secretion and accumulation that filled the middle ear space. The inflammatory response led to significant mucosal cellular hypertrophy and active secretion of mucins and other fluids. When peptide P13 was injected with the bacteria, a significant reduction was seen in fluid accumulation into the middle ear space and reduced mucosal hypertrophy.

Table 5: Peptide Inhibition of Middle Ear Inflammation[a]

Treatment	Fluid Area (microns^2 ± S.D.)	Cell Number (± S.D.)	Tympanic Membrane Thickness (microns ±

			S.D.)
PBS[b]	1016 ± 1397	31 ± 41	44 ± 20
S. *pneumoniae*[c]	5771± 2077	252 ± 140	105 ± 33
S. pneumoniae + peptide[c]	1486 ± 1192	111 ± 119	44 ± 15
p value (2-tailed)[d]	p=0.004	p=0.020	p=0.002

[a] Middle ear inflammation is assessed by measuring three consecutive tissue sections for area of fluid in the middle ear, number of cells in the middle ear fluid, and thickness of the tympanic membrane measured at a point away from the injection site. Data represent the mean ± SD animals with middle ear inflammation. Statistical evaluation is done using a paired t-test.

[b] The PBS treated animals receive no bacteria or peptides.

[c] Animals are injected in one ear with *S. pneumoniae* + PBS and in the opposite ear with *S. pneumoniae* + peptide (about 10 μM).

[d] Statistical evaluation using a paired t-test is done using data collected from diseased animals injected with bacteria and comparing peptide vs. no peptide treatment.

EXAMPLE 8: Assay for Crossing the Tympanic Membrane by FITC-labeled P13-R^9

[0114] BALB/c mice were injected through the bulla by the following protocol.

[0115] Three BALB/c mice at 8-12 weeks of age were anesthetized with ketamine (100 mg/kg) and xylazine (20 mg/kg) prior to administration of bacteria. A ventral midline incision was made in the neck, and the bulla exposed after blunt dissection. The middle ear was inoculated through the bony wall with approximately 3.5 μl of a bacterial suspension (heat inactivated *S. pneumoniae* 10^{10} CFU/ml) with a thin needle. Both the right and left ears received bacteria by bulla injection.

[0116] After 24 hours, animals received an otoscopic exam using an operating microscope. Mice were anesthetized as described above, and the tympanic membrane was inspected for the presence or absence of the following three criteria for acute otitis media (AOM): 1) middle ear effusion behind the tympanic membrane; 2) change in color of the tympanic membrane from clear to red or white (indicating inflammation and/or purulence in the middle ear); 3) change in position of the tympanic membrane from neutral to bulging or retracted. Only animals demonstrating AOM by these criteria were used.

[0117] Four ears met the criteria for AOM. FITC labeled peptide P13-R^9 (10 μg/30 μl) was dropped onto the middle ear. The peptide was allowed to absorb for 10 minutes. After 10 minutes, the external ear canal was flushed twice, and blotted to get rid of any remaining peptide. The middle ear fluid was then aspirated with a 10 μl Hamilton syringe with a 30 g

needle, and the fluid smeared on a slide. FITC-labeled peptide was viewed under a fluorescent scope. The photograph demonstrates that FITC-labeled P13-R^9 crosses the tympanic membrane and associates with cells in middle ear fluid.

[0118] Figure 1A illustrates bright field microscopy of cells in middle ear fluid. Figure 1B illustrates fluorescent microscopy of FITC-labeled P13-R^9 associated with cells in middle ear fluid.

EXAMPLE 9: Topical administration of P13 reduced middle ear inflammation and fluid retention

[0119] In this experiment, P13 was administered by ear drops to reduce inflammation and fluid retention in the pre-clinical AOM model. BALB/c mice (n=13) received an otoscopic exam using an operating microscope to establish the clinical symptoms of AOM. Mice were anesthetized and the tympanic membrane (TM) inspected for presence or absence of the following 3 criteria for AOM: 1) middle ear effusion behind the TM; 2) change in color of the TM from clear to red or white, indicating inflammation and/or purulence in the middle ear; and 3) change in position of the TM from neutral to bulging or retracted. An animal exhibiting any of these changes was scored positive for inflammation. All mice scored negative on pre-screen and were injected transtympanically with 5 µl heat inactivated *S. pneumonia* (10^9 CFU/ml) in both ears. Twenty-four hours post bacterial injection, mice were examined by otoscopic exam and those animals meeting the inflammation criteria described above remained in the study. Of the thirteen ears scored as positive; seven ears were treated topically with P13 (1 µg/30 µl), and six ears treated topically with PBS (30 µl). For topical treatment, animals were lightly anesthetized and P13 or PBS was dropped onto the external tympanic membrane. The animals remained sedated for 15-20 minutes. Seventy-two hours post bacterial injection, animals were sacrificed and tissue histologically processed to assess middle ear disease. Inflammation was quantified by measuring the area of fluid present in the middle ear and number of cells in the measured middle ear fluid area as follows. Mice were overdosed on anesthetic and perfused intracardially with 1.0 ml of saline, followed by 20 ml of fixative (1.5% paraformaldehyde-3% glutaraldehyde in 0.1 M phosphate buffer). Middle ears were decalcified, embedded in glycol methacrylate plastic, sectioned at 5 µm, mounted serially on glass slides stained, and cover-slipped. Three consecutive sections at the level of the umbo and promontory were selected for measures of 1) area of fluid present in the middle ear; and 2) number of cells in middle ear fluid. Each measurement was taken on the three

sequential sections per specimen. The value presented for each parameter represents the mean of the three sections (FIGURE 2). This experiment confirmed that ear drop administration of P13 dramatically reduced both the cellular infiltration and residual fluid in the pre-clinical AOM model. Of interest, the one animal in the P13 treatment group showing high cell number and high fluid area is the same animal.

EXAMPLE 10: Topical administration of P13 significantly reduced the severity and longevity of hearing impairment

A. Topical administration of P13 demonstrated efficacy in a mouse model of AOM.

[0120] Patients with AOM frequently experience residual middle ear fluid retention which can lead to impaired hearing, recurrent infections, and in extreme conditions the need for surgical placement of ear tubes. To determine whether topical administration of P13 would impact hearing in a pre-clinical model of AOM, BALB/c mice (n=8), 13 weeks of age, received a baseline auditory brainstem response (ABR) and otoscopic exam in both ears. ABR stimuli consisted of 20 tone-burst trains at 4 kHz, 8 kHz, 16 kHz and 32 kHz at five intensity levels in 10 dB steps. Each tone-burst had a two-ms duration, with tone burst onsets separated by 12 ms. Two separate trains offset by 5 dB were presented as stimuli, then combined in data analysis to determine threshold in 5 dB steps. Responses to 300 stimulus repetitions were averaged using a digital oscilloscope. Thresholds were based on the lowest intensity at which a response could be identified. The number of waves present at threshold varied somewhat, but the presence of at least two waves was considered a valid threshold. An otoscopic exam was performed using an operating microscope to establish the clinical symptoms of AOM, as previously described. All 8 animals remained in the study and were injected transtympanically with 5 µl heat inactivated *S. pneumonia* (10^9 CFU/ml) in both ears. Twenty-four hours post bacterial injection, mice were examined by otoscopic exam and those animals meeting the inflammation criteria remained in this study. After 24 hours, each animal was treated topically with P13 (1 µg/30 µl) in one ear, and PBS (30 ul) in the other. For topical treatment, animals were lightly anesthetized and P13 or PBS dropped onto the external tympanic membrane. The animals remained sedated for 15-20 minutes.

[0121] Five and 13 days after bacterial injection, all animals received ABR testing as described above. ABR data was calculated by subtracting the baseline ABR from the post-bacterial ABR for each frequency, and then summing all 4 frequencies (4, 8, 16 and 32 kHz). A two-way repeated measure ANOVA was done for data analysis using days 5 and 13. This

experiment confirmed that ear drop administration of P13 significantly limited the hearing impairment seen in control treated animals. Treatment with P13 reduced the severity of hearing impairment and reduced the time to resolution to normal baseline hearing levels (FIGURE 3A). P13 treatment dramatically reduced the number of animals with hearing loss as compared to PBS treatment (FIGURE 3B). In summary, these data confirmed the efficacy of P13 in reducing the severity and longevity of hearing impairment.

B. Topical administration of P13 demonstrated efficacy in a mouse model of chronic otitis media.

[0122] Eight C3H/HeJ mice (12 months of age) were given a clinical ear examination. Those animals demonstrating middle ear inflammation (6 mice) were given two baseline ABRs, one week apart, and then each ear was treated topically with either PBS, or 1 μg P13. One and two weeks after P13/PBS treatment, animals again received an otoscopic exam and an ABR assessment. ABR data were calculated by subtracting the baseline ABR from the post-treatment ABR for each frequency, and then summing all 4 frequencies. Topical P13 treatment resulted in a statistically significant improvement in hearing thresholds as assessed by ABR measurements across all four frequencies at both weeks 1 and 2 post-treatment. This data showed a dramatic improvement in hearing thresholds at both time-points, with an approximate 40 db improvement at week 2. An examination of a single frequency (4 kHz) demonstrated the impact of P13 treatment on hearing, where at week 2 post-treatment, there was an approximate 12 db hearing improvement in P13 treated animals as compared to controls. No change was observed in the middle ear inflammatory status as assessed by otoscopic exam after peptide treatment at either time point.

C. Comparison of the D- and L-isomer forms of P13 in treating COM.

[0123] The biological half-life of peptides can be improved by using the D-isomer of amino acid residues in place of the L-isomer form. A stereoisomer of P13 containing all D-amino acid residues (D-P13) was therefore tested for efficacy in treating C3H/HeJ mice with COM, and the results were compared to those obtained with the stereoisomer containing all L-amino acid residues (L-P13). The D-P13 peptide was produced by standard methods and was purified to >95%. Three C3H/HeJ mice with COM were treated topically with D-P13 in both ears as described above and ABRs assessed at weeks 1 and 2 post-treatment. Similar to what was seen with L-P13 treatment, treatment with D-P13 also demonstrated efficacy in improving hearing thresholds in COM mice with clinically documented disease. At week 2 post-treatment, D-P13 improved hearing thresholds across all frequencies approximately 20

db as compared to an approximate 40 db improvement after treatment with L-P13. While the L-isomer of P13 showed a more pronounced improvement of hearing thresholds, the D- and L-isomer forms of P13 exhibited similar levels of statistical confidence in this experiment.

EXAMPLE 11: Topical administration of P13 lacked ototoxicity

[0124] P13 was investigated for possible negative impact on hearing in normal mice upon administration by ear drops. BALB/c mice, 16 weeks of age, (n=16) received two baseline auditory brainstem response (ABR) tests one week apart, and an otoscopic exam in both ears. ABR stimuli consisted of 20 tone-burst trains at 4 kHz, 8 kHz, 16 kHz and 32 kHz at five intensity levels in 10 dB steps, as previously described. An otoscopic exam was performed using an operating microscope to establish the clinical symptoms of AOM, as previously described. Any animal with an abnormal ABR or exam on pre-screen was not entered into the study.

[0125] All 16 animals remained in the study and were divided into five groups as follows:

group 1: (n=6 ears) 1 µg P13/30 µl, topically, given once;

group 2: (n=7 ears) 10 µg P13/30 µl, topically, given once;

group 3: (n=7 ears) 10 µg P13/30 µl, topically, given twice, 24 hours apart;

group 4: (n=6 ears) 60 µg P13/30 µl, topically, given once; and

group 5: (n=6 ears) untreated mice.

[0126] ABRs were performed at one, two, three and four weeks post P13 treatment. The two baseline ABRs were averaged and compared to the ABRs post P13 treatment. This experiment demonstrated that topical administration of P13 did not negatively impact hearing thresholds in these normal mice.

EXAMPLE 12: Evaluation of TNF-α Secretion in Mice Treated With Peptides

[0127] The effect of several peptides on TNF-α secretion in mice in response to stimulation by CpG-ODN and LPS is studied. Peptide compositions are prepared for each peptide-R^9, at 3 concentrations, 37 µM, 22.2 µM, and 11.1 µM, and tested. Peptides demonstrating activity in this assay are further formulated into peptide compositions at 11.1 µM, 7.4 µM, and 3.7 µM for re-assay.

[0128] BALB/c (Bagg albino) mice, about 8–12 weeks of age, are anesthetized with a subcutaneous injection of xylazine & ketamine (about 0.1 mg/30 gm body weight). The mice are injected in both ears with either 1.25 ug/ml CpG-ODN or 1 ng/ml LPS. Twenty-four hours later the mice are treated topically (ear drop) with 1 µg peptide/30 µl in one ear and PBS (30 µl) in the

other. Twenty-four hours post peptide/PBS treatment, middle ear fluid is collected and analyzed for TNF-α secretion by ELISA. Ears exhibiting lesser TNF-α secretion than the control ears identify peptides that effectively inhibit TNF-α secretion in the live mouse.

EMBODIMENTS

[0129] The following embodiments provide non-limiting examples of objects of the invention.

[0130] In some embodiments, the invention contemplates a pharmaceutical composition comprising a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue.

[0131] In some embodiments, the pharmaceutical composition of claim 1, wherein the peptide further comprises a transducing sequence at the C-terminus.

[0132] In some embodiments, the transducing sequence is a poly-arginine sequence.

[0133] In some embodiments, the transducing sequence comprises nine consecutive arginine residues.

[0134] In some embodiments, the transducing sequence consists of nine consecutive arginine residues.

[0135] In some embodiments, the peptide comprises a derivative of P13 comprising at least one D-amino acid residue.

[0136] In some embodiments, the amino acid residues of the peptide are D-amino acid residues.

[0137] In some embodiments, the amino acid residues that are not part of the transducing sequence are D-amino acid residues.

[0138] In some embodiments, at least one amino acid residue of the transducing sequence is a D-amino acid residue.

[0139] In some embodiments, all the amino acid residues of the transducing sequence are D-amino acid residues.

[0140] In some embodiments, the peptide is any one of SEQ ID NOS: 42-44, 68-77, 79-81, 83, 102-106, 133, 141, 151, 166, 167, 181, and 182.

[0141] In some embodiments, the peptide is any one of SEQ ID NOS: 228-230, 254-263, 265-267, 269, 288-292, 319, 327, 337, 352, 353, 367, and 368.

[0142] In some embodiments, the pharmaceutical composition further comprises a pharmaceutically acceptable excipient.

[0143] In some embodiments, the pharmaceutical composition is in the form of a drop.

[0144] In some embodiments, the pharmaceutical composition is in the form of an aerosol, vapor, spray, or mist.

[0145] In some embodiments, the invention contemplates a pharmaceutical composition comprising a peptide comprising a sequence of any one of SEQ ID NOS: 1-186.

[0146] In some embodiments, the invention contemplates a peptide comprising the sequence of any one of SEQ ID NOS: 1-368.

[0147] In some embodiments, the peptide comprises the sequence of any one of SEQ ID NOS: 42-44, 68-77, 79-81, 83, 102-106, 133, 141, 151, 166, 167, 181, 182, 228-230, 254-263, 265-267, 269, 288-292, 319, 327, 337, 352, 353, 367, and 368.

[0148] In some embodiments, the invention contemplates a derivative of a peptide comprising the sequence of any one of SEQ ID NOS: 1-369, wherein the derivative comprises at least one D-amino acid residue.

[0149] In some embodiments, the invention contemplates a method of regulating cellular activity, the method comprising administering to an organism in need or want thereof an effective amount of a pharmaceutical composition comprising a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0150] In some embodiments, the cellular activity is mediated by a toll-like receptor.

[0151] In some embodiments, the cellular activity mediated by a toll-like receptor is TNF-α secretion.

[0152] In some embodiments, the method provides 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% inhibition of TNF-α secretion following stimulation by LPS and/or CpG-ODN.

[0153] In some embodiments, the administering results in an inhibition of cytokine secretion.

[0154] In some embodiments, the invention contemplates a method of treating inflammation in an animal, the method comprising administering to an animal in need or want thereof a pharmaceutical composition comprising a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0155] In some embodiments, the inflammation is caused by a virus, bacteria, fungi, antigen, self-antigen, or a combination thereof.

[0156] In some embodiments, the inflammation is ear inflammation.

[0157] In some embodiments, the inflammation is otitis media.

[0158] In some embodiments, the administration reduces or eliminates a symptom of otitis media.

[0159] In some embodiments, the symptom is pain, otorrhea, fever, irritability, anorexia, vomiting or diarrhea.

[0160] In some embodiments, the symptom is pain.

[0161] In some embodiments, the inflammation is inflammation of the skin, joints, muscular tissue, brain, or connective tissue.

[0162] In some embodiments, the inflammation is arthritis, dermatitis, Lupus erythematosus, meningitis, or psoriasis.

[0163] In some embodiments, the arthritis is osteoarthritis, rheumatoid arthritis, septic arthritis, gout, pseudo-gout, juvenile idiopathic arthritis, Still's disease, or ankylosing spondylitis.

[0164] In some embodiments, the dermatitis is spongiotic dermatitis, childhood eczema, allergic contact dermatitis, seborrhoeic dermatitis, dyshidrotic dermatitis, urticaria, vesicular or bullous dermatitis, or papular urticaria.

[0165] In some embodiments, the psoriasis is plaque psoriasis, flexural psoriasis, guttate psoriasis, pustular psoriasis, nail psoriasis, psoriatic arthritis, or erythrodermic psoriasis.

[0166] In some embodiments, the pharmaceutical composition is administered via topical application.

[0167] In some embodiments, the topical application comprises application to the skin, hair, outer ear, tympanic membrane, buccal cavity, nasal cavity, or sublingual cavity.

[0168] In some embodiments, the topical application comprises application to the tympanic membrane.

[0169] In some embodiments, the application to the tympanic membrane comprises the application of drops to the tympanic membrane.

[0170] In some embodiments, the animal is a human.

[0171] In some embodiments, the invention contemplates a method of treating sinusitis, the method comprising administering an aerosol composition to an organism in need or want thereof, the aerosol composition comprising a therapeutically-effective amount of a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0172] In some embodiments, the invention contemplates a method of improving hearing in an animal, the method comprising administering to an animal having middle and/or inner ear inflammation and reduced hearing a therapeutically-effective amount of a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus, wherein the peptide is administered topically, wherein the hearing improves to a level no better than ordinary levels, and/or the hearing improves faster than the hearing would improve without administration of the peptide.

[0173] In some embodiments, the invention contemplates a method of treating middle and/or inner ear inflammation, the method comprising administering to a tympanic membrane of an animal in need or want thereof a therapeutically-effective amount of a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0174] In some embodiments, the invention contemplates a use of a peptide in the manufacture of a medicament for regulating cellular activity, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0175] In some embodiments, the cellular activity is mediated by a toll-like receptor.

[0176] In some embodiments, the cellular activity mediated by a toll-like receptor is TNF-α secretion.

[0177] In some embodiments, the medicament provides 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% inhibition of TNF-α secretion following stimulation by LPS and/or CpG-ODN.

[0178] In some embodiments, the medicament is suitable to inhibit cytokine secretion.

[0179] In some embodiments, the invention contemplates a use of a peptide in the manufacture of a medicament for treating inflammation in an animal, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0180] In some embodiments, the inflammation is caused by a virus, bacteria, fungi, antigen, self-antigen, or a combination thereof.

[0181] In some embodiments, the inflammation is ear inflammation.

[0182] In some embodiments, the inflammation is otitis media.

[0183] In some embodiments, the administration reduces or eliminates a symptom of otitis media.

[0184] In some embodiments, the symptom is pain, otorrhea, fever, irritability, anorexia, vomiting or diarrhea.

[0185] In some embodiments, the symptom is pain.

[0186] In some embodiments, the inflammation is inflammation of the skin, joints, muscular tissue, brain, or connective tissue.

[0187] In some embodiments, the inflammation is arthritis, dermatitis, Lupus erythematosus, meningitis, or psoriasis.

[0188] In some embodiments, the arthritis is osteoarthritis, rheumatoid arthritis, septic arthritis, gout, pseudo-gout, juvenile idiopathic arthritis, Still's disease, or ankylosing spondylitis.

[0189] In some embodiments, the dermatitis is spongiotic dermatitis, childhood eczema, allergic contact dermatitis, seborrhoeic dermatitis, dyshidrotic dermatitis, urticaria, vesicular or bullous dermatitis, or papular urticaria.

[0190] In some embodiments, the psoriasis is plaque psoriasis, flexural psoriasis, guttate psoriasis, pustular psoriasis, nail psoriasis, psoriatic arthritis, or erythrodermic psoriasis.

[0191] In some embodiments, the medicament is suitable for topical application.

[0192] In some embodiments, the topical application comprises application to the skin, hair, outer ear, tympanic membrane, buccal cavity, nasal cavity, or sublingual cavity.

[0193] In some embodiments, the topical application comprises application to the tympanic membrane.

[0194] In some embodiments, the application to the tympanic membrane comprises the application of drops to the tympanic membrane.

In some embodiments, the animal is a human.

[0195] In some embodiments, the invention contemplates a use of a peptide in the manufacture of a medicament for treating sinusitis, the medicament comprising an aerosol composition, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0196] In some embodiments, the invention contemplates a use of a peptide in the manufacture of a medicament for improving hearing in an animal, wherein the animal has middle and/or inner ear inflammation and reduced hearing, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus, wherein the medicament is a topical medicament.

[0197] In some embodiments, the invention contemplates a use of a peptide in the manufacture of a medicament for treating middle and/or inner ear inflammation, wherein the medicament is suitable for administration to a tympanic membrane of an animal in need or want thereof, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

[0198] Embodiment 101. A composition comprising a peptide comprising the amino acid sequence FTILEEYFMY (SEQ ID NO: 371).

[0199] Embodiment 102. The composition of embodiment 101, wherein the peptide is selected from the group consisting of S1-S17.

[0200] Embodiment 103. The composition of embodiment 101, wherein peptide further comprises a transducing sequence.

[0201] Embodiment 104. The composition of embodiment 103, wherein the transducing sequence comprises a 9-arginine sequence positioned at the C-terminus.

[0202] Embodiment 105. A method of regulating cellular activity comprising administering a peptide to a cell, said peptide comprising the amino acid sequence FTILEEYFMY (SEQ ID NO: 371).

[0203] Embodiment 106. The method of embodiment 105, wherein the peptide is selected from the group consisting of S1-S17.

[0204] Embodiment 107. The method of embodiment 105, wherein the peptide further comprises a transducing sequence.

[0205] Embodiment 108. The method of embodiment 106, wherein the transducing sequence comprises a 9-arginine sequence positioned at the C-terminus.

[0206] Embodiment 109. The method of embodiment 105, wherein the activity is mediated by toll-like receptor.

[0207] Embodiment 110. The method of embodiment 105, wherein the administration results in an inhibition of cytokine secretion.

[0208] Embodiment 111. The method of embodiment 106, wherein the peptide is used in the treatment of inflammation.

[0209] Embodiment 112. The method of embodiment 111, wherein the inflammation is caused by a virus, bacteria, fungi, antigen, self-antigen, or a combination thereof.

[0210] Embodiment 113. The method of embodiment 105, wherein the administration of said peptide to said cell results in a 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% inhibition of TNF-α secretion following stimulation by CpG-ODN.

[0211] Embodiment 114. A method of decreasing TNF-α secretion in response to toll-like receptor signaling comprising administering a therapeutically effective dose of a peptide derived from A52R.

[0212] Embodiment 115. A pharmaceutical composition comprising:

a peptide comprising the amino acid sequence set forth in any one of the peptides selected from S1-S17;

a 9-arginine sequence positioned at the C-terminus of the said peptide; and

a pharmaceutically-acceptable excipient,

wherein said composition is used for the treatment inflammation.

[0213] Embodiment 201. A composition comprising a peptide comprising the amino acid sequence LEEYFMY (SEQ ID NO: 370).

[0214] Embodiment 202. The composition of embodiment 201, wherein the peptide is selected from the group consisting of S1-S22.

[0215] Embodiment 203. The composition of embodiments 201 or 202, wherein peptide further comprises a transducing sequence.

[0216] Embodiment 204. The composition of embodiment 203, wherein the transducing sequence comprises a 9-arginine sequence positioned at the C-terminus.

[0217] Embodiment 205. The composition of embodiments 201 or 202, wherein the peptide comprises a L-isomer amino acid or a D-isomer amino acid or L- and D- isomer amino acids.

[0218] Embodiment 206. The composition of embodiment 203, wherein the peptide and/or the transducing sequence comprises a L-isomer amino acid or a D-isomer amino acid or L- and D- isomer amino acids.

[0219] Embodiment 207. A method of regulating cellular activity comprising administering a peptide to a cell, said peptide comprising the amino acid sequence LEEYFMY (SEQ ID NO: 370).

[0220] Embodiment 208. The method of embodiment 207, wherein the peptide is selected from the group consisting of S1-S22.

[0221] Embodiment 209. The method of embodiments 207 or 208, wherein the peptide further comprises a transducing sequence.

[0222] Embodiment 210. The method of embodiment 209, wherein the transducing sequence comprises a 9-arginine sequence positioned at the C-terminus.

[0223] Embodiment 211. The method of embodiments 207 or 208, wherein the peptide comprises a L-isomer amino acid or a D-isomer amino acid or L- and D-isomer amino acids.

[0224] Embodiment 212. The method of embodiment 209, wherein the peptide and/or the transducing sequence comprises a L-isomer amino acid or a D-isomer amino acid or L- and D-isomer amino acids.

[0225] Embodiment 213. The method of embodiment 207, wherein the activity is mediated by toll-like receptor.

[0226] Embodiment 214. The method of embodiment 207, wherein the administration results in an inhibition of cytokine secretion.

[0227] Embodiment 215. The method of embodiment 208, wherein the peptide is used in the treatment of inflammation.

[0228] Embodiment 216. The method of embodiment 215, wherein the inflammation is caused by a virus, bacteria, fungi, antigen, self-antigen, or a combination thereof.

[0229] Embodiment 217. The method of embodiment 207, wherein the administration of said peptide to said cell results in a 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% inhibition of TNF-α secretion following stimulation by CpG-ODN.

[0230] Embodiment 218. A method of decreasing TNF-α secretion in response to toll-like receptor signaling comprising administering a therapeutically effective dose of a peptide derived from A52R.

[0231] Embodiment 219. A pharmaceutical composition comprising: (a) a peptide comprising the amino acid sequence set forth in any one of the peptides selected from S1-S22; (b) a 9-arginine sequence positioned at the C-terminus of the said peptide; and a pharmaceutically-acceptable excipient, wherein said composition is used for the treatment inflammation.

[0232] Embodiment 301. A composition comprising a peptide comprising the amino acid sequence VYDCI (SEQ ID NO: 372), VYACI (SEQ ID NO: 373), KLTVY (SEQ ID NO: 374), KLYVY (SEQ ID NO: 375), or KVYVY (SEQ ID NO: 376).

[0233] Embodiment 302. The composition of embodiment 301, wherein the peptide is selected from the group consisting of the peptides presented in Table 1.

[0234] Embodiment 303. The composition of embodiment 301, wherein peptide further comprises a transducing sequence.

[0235] Embodiment 304. The composition of embodiment 303, wherein the transducing sequence comprises a 9-arginine sequence positioned at the C-terminus.

[0236] Embodiment 305. A method of regulating cellular activity comprising administering a peptide to a cell, said peptide comprising the amino acid sequence VYDCI (SEQ ID NO: 372), VYACI (SEQ ID NO: 373), KLTVY (SEQ ID NO: 374), KLYVY (SEQ ID NO: 375), or KVYVY (SEQ ID NO: 376).

[0237] Embodiment 306. The method of embodiment 305, wherein the peptide is selected from the group consisting of the peptides presented in Table 1.

[0238] Embodiment 307. The method of embodiment 305, wherein the peptide further comprises a transducing sequence.

[0239] Embodiment 308. The method of embodiment 306, wherein the transducing sequence comprises a 9-arginine sequence positioned at the C-terminus.

[0240] Embodiment 309. The method of embodiment 305, wherein the activity is mediated by toll-like receptor.

[0241] Embodiment 310. The method of embodiment 305, wherein the administration results in an inhibition of cytokine secretion.

[0242] Embodiment 311. The method of embodiment 306, wherein the peptide is used in the treatment of inflammation.

[0243] Embodiment 312. The method of embodiment 311, wherein the inflammation is caused by a virus, bacteria, fungi, antigen, self-antigen, or a combination thereof.

[0244] Embodiment 313. The method of embodiment 305, wherein the administration of said peptide to said cell results in a 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% inhibition of TNF-α secretion following stimulation by CpG-ODN.

[0245] Embodiment 314. The method of embodiment 305, wherein the administration of said peptide to said cell results in a 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% inhibition of TNF-α secretion following stimulation by LPS.

[0246] Embodiment 315. A method of decreasing TNF-α secretion in response to toll-like receptor signaling comprising administering a therapeutically effective dose of a peptide derived from P13.

[0247] Embodiment 316. A pharmaceutical composition comprising:

a peptide comprising the amino acid sequence set forth in any one of the peptides selected from the peptides listed in Table 1;

a 9-arginine sequence positioned at the C-terminus of the said peptide; and

a pharmaceutically-acceptable excipient,

wherein said composition is used for the treatment inflammation.

[0248] Embodiment 401. A composition comprising a peptide comprising the amino acid sequence VYACI (SEQ ID NO: 373), KLYVY (SEQ ID NO: 375), or KVYVY (SEQ ID NO: 376).

[0249] Embodiment 402. The composition of embodiment 401, wherein the peptide is selected from the group consisting of the peptides presented in Table 1.

[0250] Embodiment 403. The composition of embodiments 401 or 402, wherein the peptide further comprises a transducing sequence.

[0251] Embodiment 404. The composition of embodiment 403, wherein the transducing sequence comprises a 9-arginine sequence positioned at the C-terminus.

[0252] Embodiment 405. The composition of embodiments 401 or 402, wherein the peptide comprises a L-isomer amino acid or a D-isomer amino acid or L- and D- isomer amino acids.

[0253] Embodiment 406. The composition of embodiment 403, wherein the peptide and/or the transducing sequence comprises a L-isomer amino acid or a D-isomer amino acid or L- and D- isomer amino acids.

[0254] Embodiment 407. A method of regulating cellular activity comprising administering a peptide to a cell, said peptide comprising the amino acid sequence VYACI (SEQ ID NO: 373), KLYVY (SEQ ID NO: 375), or KVYVY (SEQ ID NO: 376).

[0255] Embodiment 408. The method of embodiment 407, wherein the peptide is selected from the group consisting of the peptides presented in Table 1.

[0256] Embodiment 409. The method of embodiments 407 or 408, wherein the peptide further comprises a transducing sequence.

[0257] Embodiment 410. The method of embodiment 409, wherein the transducing sequence comprises a 9-arginine sequence positioned at the C-terminus.

[0258] Embodiment 411. The method of embodiments 407 or 408, wherein the peptide comprises a L-isomer amino acid or a D-isomer amino acid or L- and D- isomer amino acids.

[0259] Embodiment 412. The method of embodiment 409, wherein the peptide and/or the transducing sequence comprises a L-isomer amino acid or a D-isomer amino acid or L- and D-isomer amino acids.

[0260] Embodiment 413. The method of embodiment 407, wherein the activity is mediated by toll-like receptor.

[0261] Embodiment 414. The method of embodiment 407, wherein the administration results in an inhibition of cytokine secretion.

[0262] Embodiment 415. The method of embodiment 408, wherein the peptide is used in the treatment of inflammation.

[0263] Embodiment 416. The method of embodiment 415, wherein the inflammation is caused by a virus, bacteria, fungi, antigen, self-antigen, or a combination thereof.

[0264] Embodiment 417. The method of embodiment 407, wherein the administration of said peptide to said cell results in a 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% inhibition of TNF-α secretion following stimulation by CpG-ODN.

[0265] Embodiment 418. The method of embodiment 407, wherein the administration of said peptide to said cell results in a 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% inhibition of TNF-α secretion following stimulation by LPS.

[0266] Embodiment 419. A method of decreasing TNF-α secretion in response to toll-like receptor signaling comprising administering a therapeutically effective dose of a peptide derived from P13.

[0267] Embodiment 420. A pharmaceutical composition comprising:

a peptide comprising the amino acid sequence set forth in any one of the peptides selected from the peptides listed in Table 1;

a 9-arginine sequence positioned at the C-terminus of the said peptide; and

a pharmaceutically-acceptable excipient,

wherein said composition is used for the treatment inflammation.

[0268] Embodiment 501. A pharmaceutical composition comprising:

a peptide comprising the amino acid sequence set forth in any one of the peptides selected from P13, a P13 variant, derivative, stereoisomer, or analogue, or a peptide of Table 1;

a 9-arginine sequence positioned at the C-terminus of the said peptide; and

a pharmaceutically-acceptable excipient,

wherein said composition is used for the treatment of inflammation.

[0269] Embodiment 502. The pharmaceutical composition of embodiment 501, wherein the inflammation comprises otitis media.

[0270] Embodiment 503. The pharmaceutical composition of embodiment 502, further comprising wherein the pharmaceutical composition is applied via topical application.

[0271] Embodiment 504. The pharmaceutical composition of embodiment 503, wherein the topical application comprises application to the skin, hair, outer ear, tympanic membrane, buccal cavity, or sublingual cavity.

[0272] Embodiment 505. The pharmaceutical composition of embodiment 504, wherein the topical application comprises application to the tympanic membrane.

[0273] Embodiment 506. The pharmaceutical composition of embodiment 505, wherein the application to the tympanic membrane comprises the application of ear drops to the tympanic membrane.

[0274] Embodiment 507. A pharmaceutical composition effective to:

decrease the amount of middle ear fluid by about 30-80 percent;

decrease an infiltrating cell number in middle ear fluid by about 30-80 percent; and

decrease the thickness of a tympanic membrane by about 30-80 percent in a mouse comprising inflammation of the ear, wherein the composition is administered to the mouse in an amount of about 0.01 ug to 60 ug.

[0275] Embodiment 508. The pharmaceutical composition of embodiment 507, comprising a peptide.

[0276] Embodiment 509. The pharmaceutical composition of embodiment 508, wherein the peptide comprises P13 or a variant, derivative, stereoisomer, or analogue thereof.

[0277] Embodiment 510. The pharmaceutical composition of embodiment 509, wherein the peptide comprises P13, a peptide comprising P13 and a poly-argenine domain, or a peptide of Table 1.

[0278] Embodiment 511. The pharmaceutical composition of embodiment 509, wherein the peptide comprises P13.

[0279] Embodiment 512. The pharmaceutical composition of embodiment 509, wherein the peptide comprises a stereoisomer of P13, wherein one or more amino acid residues of the stereoisomer comprise the D-configuration.

[0280] Embodiment 513. The pharmaceutical composition of embodiment 512, wherein the peptide comprises a stereoisomer of P13 wherein all the amino acid residues of the stereoisomer comprise the D-configuration.

[0281] Embodiment 514. The pharmaceutical composition of embodiment 507, wherein the inflammation comprises otitis media.

[0282] Embodiment 515. The pharmaceutical composition of embodiment 514, comprising a peptide.

[0283] Embodiment 516. The pharmaceutical composition of embodiment 515, wherein the peptide comprises P13 or a variant, derivative, stereoisomer, or analogue thereof.

[0284] Embodiment 517. The pharmaceutical composition of embodiment 516, wherein the peptide comprises P13, a peptide comprising P13 and a poly-argenine domain, or a peptide of Table 1.

[0285] Embodiment 518. The pharmaceutical composition of embodiment 516, wherein the peptide comprises P13.

[0286] Embodiment 519. The pharmaceutical composition of embodiment 516, wherein the peptide comprises a stereoisomer of P13, wherein one or more amino acid residues of the stereoisomer comprise the D-configuration.

[0287] Embodiment 520. The pharmaceutical composition of embodiment 519, wherein the peptide comprises a stereoisomer of P13 wherein all the amino acid residues of the stereoisomer comprise the D-configuration.

[0288] Embodiment 521. The pharmaceutical composition of embodiment 514, further comprising wherein the pharmaceutical composition is applied via topical application.

[0289] Embodiment 522. The pharmaceutical composition of embodiment 521, comprising a peptide.

[0290] Embodiment 523. The pharmaceutical composition of embodiment 522, wherein the peptide comprises P13 or a variant, derivative, stereoisomer, or analogue thereof.

[0291] Embodiment 524. The pharmaceutical composition of embodiment 523, wherein the peptide comprises P13, a peptide comprising P13 and a poly-argenine domain, or a peptide of Table 1.

[0292] Embodiment 525. The pharmaceutical composition of embodiment 523, wherein the peptide comprises P13.

[0293] Embodiment 526. The pharmaceutical composition of embodiment 523, wherein the peptide comprises a stereoisomer of P13, wherein one or more amino acid residues of the stereoisomer comprise the D-configuration.

[0294] Embodiment 527. The pharmaceutical composition of embodiment 526, wherein the peptide comprises a stereoisomer of P13 wherein all the amino acid residues of the stereoisomer comprise the D-configuration.

[0295] Embodiment 528. The pharmaceutical composition of embodiment 521, wherein the topical application comprises application to the skin, hair, outer ear, tympanic membrane, buccal cavity, or sublingual cavity.

[0296] Embodiment 529. The pharmaceutical composition of embodiment 528, comprising a peptide.

[0297] Embodiment 530. The pharmaceutical composition of embodiment 529, wherein the peptide comprises P13 or a variant, derivative, stereoisomer, or analogue thereof.

[0298] Embodiment 531. The pharmaceutical composition of embodiment 530, wherein the peptide comprises P13, a peptide comprising P13 and a poly-argenine domain, or a peptide of Table 1.

[0299] Embodiment 532. The pharmaceutical composition of embodiment 530, wherein the peptide comprises P13.

[0300] Embodiment 533. The pharmaceutical composition of embodiment 530, wherein the peptide comprises a stereoisomer of P13, wherein one or more amino acid residues of the stereoisomer comprise the D-configuration.

[0301] Embodiment 534. The pharmaceutical composition of embodiment 533, wherein the peptide comprises a stereoisomer of P13 wherein all the amino acid residues of the stereoisomer comprise the D-configuration.

[0302] Embodiment 535. The pharmaceutical composition of embodiment 528, wherein the topical application comprises application to the tympanic membrane.

[0303] Embodiment 536. The pharmaceutical composition of embodiment 535, comprising a peptide.

[0304] Embodiment 537. The pharmaceutical composition of embodiment 536, wherein the peptide comprises P13 or a variant, derivative, stereoisomer, or analogue thereof.

[0305] Embodiment 538. The pharmaceutical composition of embodiment 537, wherein the peptide comprises P13, a peptide comprising P13 and a poly-argenine domain, or a peptide of Table 1.

[0306] Embodiment 539. The pharmaceutical composition of embodiment 537, wherein the peptide comprises P13.

[0307] Embodiment 540. The pharmaceutical composition of embodiment 537, wherein the peptide comprises a stereoisomer of P13, wherein one or more amino acid residues of the stereoisomer comprise the D-configuration.

[0308] Embodiment 541. The pharmaceutical composition of embodiment 540, wherein the peptide comprises a stereoisomer of P13 wherein all the amino acid residues of the stereoisomer comprise the D-configuration.

[0309] Embodiment 542. The pharmaceutical composition of embodiment 535, wherein the application to the tympanic membrane comprises the application of ear drops to the tympanic membrane.

[0310] Embodiment 543. The pharmaceutical composition of embodiment 542, comprising a peptide.

[0311] Embodiment 544. The pharmaceutical composition of embodiment 543, wherein the peptide comprises P13 or a variant, derivative, stereoisomer, or analogue thereof.

[0312] Embodiment 545. The pharmaceutical composition of embodiment 544, wherein the peptide comprises P13, a peptide comprising P13 and a poly-argenine domain, or a peptide of Table 1.

[0313] Embodiment 546. The pharmaceutical composition of embodiment 544, wherein the peptide comprises P13.

[0314] Embodiment 547. The pharmaceutical composition of embodiment 544, wherein the peptide comprises a stereoisomer of P13, wherein one or more amino acid residues of the stereoisomer comprise the D-configuration.

[0315] Embodiment 548. The pharmaceutical composition of embodiment 547, wherein the peptide comprises a stereoisomer of P13 wherein all the amino acid residues of the stereoisomer comprise the D-configuration.

[0316] Embodiment 549. A method of treating ear inflammation in an animal in need or want thereof, the method comprising administering to the animal the pharmaceutical composition of embodiment 507.

[0317] Embodiment 550. The method of embodiment 549, wherein the ear inflammation comprises otitis media.

[0318] Embodiment 551. The method of embodiment 550, further comprising wherein the pharmaceutical composition is applied via topical application.

[0319] Embodiment 552. The method of embodiment 551, wherein the topical application comprises application to the skin, hair, outer ear, tympanic membrane, buccal cavity, or sublingual cavity.

[0320] Embodiment 553. The method of embodiment 552, wherein the topical application comprises application to the tympanic membrane.

[0321] Embodiment 554. The method of embodiment 553, wherein the application to the tympanic membrane comprises the application of ear drops to the tympanic membrane.

[0322] Embodiment 555. The method of embodiment 549, 550, 551, 552, 553, or 554, wherein the pharmaceutical composition comprises P13, a P13 variant, derivative, stereoisomer, or analogue, or a peptide of Table 1.

[0323] Embodiment 556. The method of embodiment 555, wherein the P13 variant, derivative, stereoisomer, or analogue comprises P13 and a poly-argenine domain.

[0324] Embodiment 557. The method of embodiment 555, wherein the pharmaceutical composition comprises P13.

[0325] Embodiment 558. The pharmaceutical composition of embodiment 555, wherein the peptide comprises a stereoisomer of P13, wherein one or more amino acid residues of the stereoisomer comprise the D-configuration.

[0326] Embodiment 559. The method of embodiment 558, wherein the peptide comprises a stereoisomer of P13 wherein all the amino acid residues of the stereoisomer comprise the D-configuration.

[0327] Embodiment 560. A method of treating ear inflammation in an animal, the method comprising administering a peptide to the animal, wherein the peptide comprises P13, a P13 variant, derivative, stereoisomer, or analogue, or a peptide of Table 1.

[0328] Embodiment 561. The method of embodiment 560, wherein the ear inflammation comprises otitis media.

[0329] Embodiment 562. The method of embodiment 561, wherein the administering of the peptide comprises application to the skin, hair, outer ear, tympanic membrane, buccal cavity, or sublingual cavity.

[0330] Embodiment 563. The method of embodiment 562, wherein the topical application comprises application to the tympanic membrane, optionally via ear drops.

[0331] Embodiment 564. The method of embodiment 563, wherein the peptide comprises P13.

[0332] Embodiment 565. The method of embodiment 564, wherein the animal is human.

[0333] Embodiment 566. The method of embodiment 563, wherein the peptide comprises P13 and a poly-argenine domain.

[0334] Embodiment 567. The method of embodiment 566, wherein the animal is human.

[0335] Embodiment 568. The method of embodiment 563, wherein the peptide comprises DIVKLTVYDCIRRRRRRRRR (SEQ ID NO: 378).

[0336] Embodiment 569. The method of embodiment 568, wherein the animal is human.

[0337] Embodiment 570. The method of embodiment 563, wherein the peptide comprises a stereoisomer of P13, wherein one or more amino acid residues of the stereoisomer comprise the D-configuration.

[0338] Embodiment 571. The method of embodiment 570, wherein the peptide comprises a stereoisomer of P13 wherein all the amino acid residues of the stereoisomer comprise the D-configuration.

[0339] Embodiment 572. The method of embodiment 571, wherein the animal is human.

[0340] Embodiment 573. The method of embodiment 563, wherein the peptide comprises an analogue of P13, wherein one or more amino acid residues of the analogue comprise the D-configuration.

[0341] Embodiment 574. The method of embodiment 573, wherein the peptide comprises an analogue of P13, wherein all the amino acid residues of the analogue corresponding to a residue of P13 comprise the D-configuration, and a poly-argenine domain.

[0342] Embodiment 575. The method of embodiment 574, wherein the animal is human.

[0343] Embodiment 576. The method of embodiment 563, wherein the peptide comprises: D-Asp-D-Ile-D-Val-D-Lys-D-Leu-D-Thr-D-Val-D-Tyr-D-Asp-D-Cys-D-Ile-Arg-Arg-Arg-Arg-Arg-Arg-Arg-Arg-Arg (SEQ ID NO: 183).

[0344] Embodiment 577. The method of embodiment 576, wherein the animal is human.

[0345] Embodiment 578. The method of embodiment 573, wherein the peptide comprises an analogue of P13, wherein all the amino acid residues of the analogue corresponding to a residue of P13 comprise the D-configuration, and a poly-argenine domain comprising at least one amino acid residue of the D-configuration.

[0346] Embodiment 579. The method of embodiment 578, wherein the animal is human.

[0347] Embodiment 580. The method of embodiment 563, wherein the peptide comprises: D-Asp-D-Ile-D-Val-D-Lys-D-Leu-D-Thr-D-Val-D-Tyr-D-Asp-D-Cys-D-Ile- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg (SEQ ID NO: 184).

[0348] Embodiment 581. The method of embodiment 580, wherein the animal is human.

[0349] Embodiment 582. A peptide comprising the amino acid sequence: D-Asp-D-Ile-D-Val-D-Lys-D-Leu-D-Thr-D-Val-D-Tyr-D-Asp-D-Cys-D-Ile-Arg-Arg-Arg-Arg-Arg-Arg-Arg-Arg-Arg (SEQ ID NO: 183).

[0350] Embodiment 583. A peptide comprising the amino acid sequence: D-Asp-D-Ile-D-Val-D-Lys-D-Leu-D-Thr-D-Val-D-Tyr-D-Asp-D-Cys-D-Ile- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg (SEQ ID NO: 184).

[0351] Embodiment 584. A peptide comprising the amino acid sequence: D-Asp-D-Ile-D-Val-D-Lys-D-Leu-D-Thr-D-Val-D-Tyr-D-Asp-D-Cys-D-Ile (SEQ ID NO: 185).

[0352] Embodiment 585. A peptide comprising the amino acid sequence: Asp-Ile-Val-Lys-Leu-Thr-Val-Tyr-Asp-Cys-Ile-D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg (SEQ ID NO: 186).

[0353] Embodiment 586. A pharmaceutical composition comprising a peptide, the peptide comprising:

P13 or a variant, derivative, stereoisomer, or analogue thereof; or

a peptide of Table 1,

wherein the composition is used for the treatment of inflammation of the skin, joints, muscular tissue, or connective tissue in a subject.

[0354] Embodiment 587. The pharmaceutical composition of embodiment 586, wherein the inflammation comprises arthritis, dermatitis, Lupus erythematosus, or psoriasis.

[0355] Embodiment 588. The pharmaceutical composition of embodiment 587, wherein the arthritis comprises osteoarthritis, rheumatoid arthritis, septic arthritis, gout, pseudo-gout, juvenile idiopathic arthritis, Still's disease, or ankylosing spondylitis.

[0356] Embodiment 589. The pharmaceutical composition of embodiment 587, wherein the dermatitis comprises spongiotic dermatitis, childhood eczema, allergic contact dermatitis, seborrhoeic dermatitis, dyshidrotic dermatitis, urticaria, vesicular or bullous dermatitis, or papular urticaria.

[0357] Embodiment 590. The pharmaceutical composition of embodiment 587, wherein the psoriasis comprises plaque psoriasis, flexural psoriasis, guttate psoriasis, pustular psoriasis, nail psoriasis, psoriatic arthritis, or erythrodermic psoriasis.

[0358] Embodiment 591. The pharmaceutical composition of embodiment 586, further comprising one or more pharmaceutically-acceptable excipients.

[0359] Embodiment 592. The pharmaceutical composition of embodiment 586, wherein the peptide comprises P13 or a variant, derivative, stereoisomer, or analogue thereof.

[0360] Embodiment 593. The pharmaceutical composition of embodiment 592, wherein the peptide comprises P13, or a peptide comprising P13 and a poly-argenine domain.

[0361] Embodiment 594. The pharmaceutical composition of embodiment 592, wherein the peptide comprises P13.

[0362] Embodiment 595. The pharmaceutical composition of embodiment 592, wherein the peptide comprises a stereoisomer of P13, wherein one or more amino acid residues of the stereoisomer comprise the D-configuration.

[0363] Embodiment 596. The pharmaceutical composition of embodiment 595, wherein the peptide comprises a stereoisomer of P13 wherein all the amino acid residues of the stereoisomer comprise the D-configuration.

[0364] Embodiment 597. The pharmaceutical composition of embodiment 592, wherein the peptide comprises P13 and a poly-argenine domain.

[0365] Embodiment 598. The pharmaceutical composition of embodiment 597, wherein the peptide comprises DIVKLTVYDCIRRRRRRRRR (SEQ ID NO: 378).

[0366] Embodiment 599. The pharmaceutical composition of embodiment 592, wherein the peptide comprises an analogue of P13, wherein one or more amino acid residues of the analogue comprise the D-configuration.

[0367] Embodiment 600. The pharmaceutical composition of embodiment 599, wherein the peptide comprises an analogue of P13, wherein all the amino acid residues of the analogue corresponding to a residue of P13 comprise the D-configuration, and a poly-argenine domain.

[0368] Embodiment 601. The pharmaceutical composition of embodiment 599, wherein the peptide comprises: D-Asp-D-Ile-D-Val-D-Lys-D-Leu-D-Thr-D-Val-D-Tyr-D-Asp-D-Cys-D-Ile-Arg-Arg-Arg-Arg-Arg-Arg-Arg-Arg-Arg (SEQ ID NO: 183).

[0369] Embodiment 602. The pharmaceutical composition of embodiment 599, wherein the peptide comprises: D-Asp-D-Ile-D-Val-D-Lys-D-Leu-D-Thr-D-Val-D-Tyr-D-Asp-D-Cys-D-Ile-D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg (SEQ ID NO: 184).

[0370] Embodiment 603. A method of treating inflammation in an animal, the method comprising administering a peptide to the animal, wherein the peptide comprises P13, a P13 variant, derivative, stereoisomer, or analogue, or a peptide of Table 1.

[0371] Embodiment 604. The method of embodiment 603, wherein the inflammation comprises arthritis, dermatitis, Lupus erythematosus, meningitis, or psoriasis.

[0372] Embodiment 605. The method of embodiment 604, wherein the arthritis comprises osteoarthritis, rheumatoid arthritis, septic arthritis, gout, pseudo-gout, juvenile idiopathic arthritis, Still's disease, or ankylosing spondylitis.

[0373] Embodiment 606. The method of embodiment 604, wherein the dermatitis comprises spongiotic dermatitis, childhood eczema, allergic contact dermatitis, seborrhoeic dermatitis, dyshidrotic dermatitis, urticaria, vesicular or bullous dermatitis, or papular urticaria.

[0374] Embodiment 607. The method of embodiment 604, wherein the psoriasis comprises plaque psoriasis, flexural psoriasis, guttate psoriasis, pustular psoriasis, nail psoriasis, psoriatic arthritis, or erythrodermic psoriasis.

[0375] Embodiment 608. The method of embodiment 603, wherein the peptide comprises P13 or a variant, derivative, stereoisomer, or analogue thereof.

[0376] Embodiment 609. The method of embodiment 608, wherein the peptide comprises P13, or a peptide comprising P13 and a poly-argenine domain.

[0377] Embodiment 610. The method of embodiment 608, wherein the peptide comprises P13.

[0378] Embodiment 611. The method of embodiment 608, wherein the peptide comprises a stereoisomer of P13, wherein one or more amino acid residues of the stereoisomer comprise the D-configuration.

[0379] Embodiment 612. The method of embodiment 611, wherein the peptide comprises a stereoisomer of P13 wherein all the amino acid residues of the stereoisomer comprise the D-configuration.

[0380] Embodiment 613. The method of embodiment 608, wherein the peptide comprises P13 and a poly-argenine domain.

[0381] Embodiment 614. The method of embodiment 613, wherein the peptide comprises DIVKLTVYDCIRRRRRRRRR (SEQ ID NO: 378).

[0382] Embodiment 615. The method of embodiment 608, wherein the peptide comprises an analogue of P13, wherein one or more amino acid residues of the analogue comprise the D-configuration.

[0383] Embodiment 616. The method of embodiment 615, wherein the peptide comprises an analogue of P13, wherein all the amino acid residues of the analogue corresponding to a residue of P13 comprise the D-configuration, and a poly-argenine domain.

[0384] Embodiment 617. The method of embodiment 615, wherein the peptide comprises: D-Asp-D-Ile-D-Val-D-Lys-D-Leu-D-Thr-D-Val-D-Tyr-D-Asp-D-Cys-D-Ile-Arg-Arg-Arg-Arg-Arg-Arg-Arg-Arg-Arg (SEQ ID NO: 183).

[0385] Embodiment 618. The method of embodiment 615, wherein the peptide comprises: D-Asp-D-Ile-D-Val-D-Lys-D-Leu-D-Thr-D-Val-D-Tyr-D-Asp-D-Cys-D-Ile- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg- D-Arg (SEQ ID NO: 184).

[0386] Embodiment 619. The method of any of embodiments 603-618, wherein the animal is a human.

[0387] Embodiment 6120. The method of any of embodiments 603-618, wherein the administering comprises topical application.

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CLAIMS

WHAT IS CLAIMED IS:

1. A pharmaceutical composition comprising a peptide comprising:
   a) a sequence of any one of SEQ ID NOS: 187-368; or
   b) a derivative of P13 comprising at least one D-amino acid residue.

2. The pharmaceutical composition of claim 1, wherein the peptide further comprises a transducing sequence at the C-terminus.

3. The pharmaceutical composition of claim 2, wherein the transducing sequence is a poly-arginine sequence.

4. The pharmaceutical composition of claim 2 or 3, wherein the transducing sequence comprises nine consecutive arginine residues.

5. The pharmaceutical composition of claim 2 or 3, wherein the transducing sequence consists of nine consecutive arginine residues.

6. The pharmaceutical composition of any one of claims 2-5, wherein the peptide comprises a derivative of P13 comprising at least one D-amino acid residue.

7. The pharmaceutical composition of any one of claims 1-6, wherein all the amino acid residues of the peptide are D-amino acid residues.

8. The pharmaceutical composition of any one of claims 2-6, wherein all the amino acid residues that are not part of the transducing sequence are D-amino acid residues.

9. The pharmaceutical composition of any one of claims 2-6, wherein at least one amino acid residue of the transducing sequence is a D-amino acid residue.

10. The pharmaceutical composition of any one of claims 2-6, wherein all the amino acid residues of the transducing sequence are D-amino acid residues.

11. The pharmaceutical composition of any one of claims 2-5, wherein the peptide is any one of SEQ ID NOS: 42-44, 68-77, 79-81, 83, 102-106, 133, 141, 151, 166, 167, 181, and 182.

12. The pharmaceutical composition of claim 1, wherein the peptide is any one of SEQ ID NOS: 228-230, 254-263, 265-267, 269, 288-292, 319, 327, 337, 352, 353, 367, and 368.

13. The pharmaceutical composition of any one of claims 1-12, further comprising a pharmaceutically acceptable excipient.

14. The pharmaceutical composition of any one of claims 1-13, wherein the pharmaceutical composition is in the form of a drop.

15. The pharmaceutical composition of any one of claims 1-14, wherein the pharmaceutical composition is in the form of an aerosol, vapor, spray, or mist.

16. A pharmaceutical composition comprising a peptide comprising a sequence of any one of SEQ ID NOS: 1-186.

17. A peptide comprising the sequence of any one of SEQ ID NOS: 1-368.

18. The peptide of claim 17, comprising the sequence of any one of SEQ ID NOS: 42-44, 68-77, 79-81, 83, 102-106, 133, 141, 151, 166, 167, 181, 182, 228-230, 254-263, 265-267, 269, 288-292, 319, 327, 337, 352, 353, 367, and 368.

19. A derivative of a peptide comprising the sequence of any one of SEQ ID NOS: 1-369, wherein the derivative comprises at least one D-amino acid residue.

20. A method of regulating cellular activity, the method comprising administering to an organism in need or want thereof an effective amount of a pharmaceutical composition comprising a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

21. The method of claim 20, wherein the cellular activity is mediated by a toll-like receptor.

22. The method of claim 21, wherein the cellular activity mediated by a toll-like receptor is TNF-α secretion.

23. The method of any one of claims 20-22, providing 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% inhibition of TNF-α secretion following stimulation by LPS and/or CpG-ODN.

24. The method of any one of claims 20-23, wherein the administering results in an inhibition of cytokine secretion.

25. A method of treating inflammation in an animal, the method comprising administering to an animal in need or want thereof a pharmaceutical composition comprising a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

26. The method of claim 25, wherein the inflammation is caused by a virus, bacteria, fungi, antigen, self-antigen, or a combination thereof.

27. The method of claim 25 or 26, wherein the inflammation is ear inflammation.

28. The method of any one of claims 25-27, wherein the inflammation is otitis media.

29. The method of any one of claims 25-28, wherein the administration reduces or eliminates a symptom of otitis media.

30. The method of claim 29, wherein the symptom is pain, otorrhea, fever, irritability, anorexia, vomiting or diarrhea.

31. The method of claim 29 or 30, wherein the symptom is pain.

32. The method of claim 25 or 26, wherein the inflammation is inflammation of the skin, joints, muscular tissue, brain, or connective tissue.

33. The method of any one of claims 25, 26, and 32, wherein the inflammation is arthritis, dermatitis, Lupus erythematosus, meningitis, or psoriasis.

34. The method of claim 33, wherein the arthritis is osteoarthritis, rheumatoid arthritis, septic arthritis, gout, pseudo-gout, juvenile idiopathic arthritis, Still's disease, or ankylosing spondylitis.

35. The method of claim 33, wherein the dermatitis is spongiotic dermatitis, childhood eczema, allergic contact dermatitis, seborrhoeic dermatitis, dyshidrotic dermatitis, urticaria, vesicular or bullous dermatitis, or papular urticaria.

36. The method of claim 33, wherein the psoriasis is plaque psoriasis, flexural psoriasis, guttate psoriasis, pustular psoriasis, nail psoriasis, psoriatic arthritis, or erythrodermic psoriasis.

37. The method of any one of claims 25-36, wherein the pharmaceutical composition is administered via topical application.

38. The method of claim 37, wherein the topical application comprises application to the skin, hair, outer ear, tympanic membrane, buccal cavity, nasal cavity, or sublingual cavity.

39. The method of claim 37 or 38, wherein the topical application comprises application to the tympanic membrane.

40. The method of claim 38 or 39, wherein the application to the tympanic membrane comprises the application of drops to the tympanic membrane.

41. The method of any one of claims 25-40, wherein the animal is a human.

42. A method of treating sinusitis, the method comprising administering an aerosol composition to an organism in need or want thereof, the aerosol composition comprising a therapeutically-effective amount of a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

43. A method of improving hearing in an animal, the method comprising administering to an animal having middle and/or inner ear inflammation and reduced hearing a therapeutically-effective amount of a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus, wherein the peptide is administered topically, wherein the hearing improves to a level no better than ordinary levels, and/or the hearing improves faster than the hearing would improve without administration of the peptide.

44. A method of treating middle and/or inner ear inflammation, the method comprising administering to a tympanic membrane of an animal in need or want thereof a therapeutically-effective amount of a peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

45. A use of a peptide in the manufacture of a medicament for regulating cellular activity, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

46. The use of claim 45, wherein the cellular activity is mediated by a toll-like receptor.

47. The use of claim 46, wherein the cellular activity mediated by a toll-like receptor is TNF-α secretion.

48. The use of any one of claims 45-47, wherein the medicament provides a 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% inhibition of TNF-α secretion following stimulation by LPS and/or CpG-ODN.

49. The use of any one of claims 45-48, wherein the medicament is suitable to inhibit cytokine secretion.

50. A use of a peptide in the manufacture of a medicament for treating inflammation in an animal, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-368; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

51. The use of claim 50, wherein the inflammation is caused by a virus, bacteria, fungi, antigen, self-antigen, or a combination thereof.

52. The use of claim 50 or 51, wherein the inflammation is ear inflammation.

53. The use of any one of claims 50-52, wherein the inflammation is otitis media.

54. The use of any one of claims 50-53, wherein the medicament reduces or eliminates a symptom of otitis media.

55. The use of claim 54, wherein the symptom is pain, otorrhea, fever, irritability, anorexia, vomiting or diarrhea.

56. The use of claim 54 or 55, wherein the symptom is pain.

57. The use of claim 50 or 51, wherein the inflammation is inflammation of the skin, joints, muscular tissue, brain, or connective tissue.

58. The use of any one of claims 50, 51, and 57, wherein the inflammation is arthritis, dermatitis, Lupus erythematosus, meningitis, or psoriasis.

59. The use of claim 58, wherein the arthritis is osteoarthritis, rheumatoid arthritis, septic arthritis, gout, pseudo-gout, juvenile idiopathic arthritis, Still's disease, or ankylosing spondylitis.

60. The use of claim 58, wherein the dermatitis is spongiotic dermatitis, childhood eczema, allergic contact dermatitis, seborrhoeic dermatitis, dyshidrotic dermatitis, urticaria, vesicular or bullous dermatitis, or papular urticaria.

61. The use of claim 58, wherein the psoriasis is plaque psoriasis, flexural psoriasis, guttate psoriasis, pustular psoriasis, nail psoriasis, psoriatic arthritis, or erythrodermic psoriasis.

62. The use of any one of claims 50-61, wherein the medicament is suitable for topical application.

63. The use of claim 62, wherein the topical application comprises application to the skin, hair, outer ear, tympanic membrane, buccal cavity, nasal cavity, or sublingual cavity.

64. The use of claim 62 or 63, wherein the topical application comprises application to the tympanic membrane.

65. The use of claim 63 or 64, wherein the application to the tympanic membrane comprises the application of drops to the tympanic membrane.

66. The use of any one of claims 50-65, wherein the animal is a human.

67. A use of a peptide in the manufacture of a medicament for treating sinusitis, the medicament comprising an aerosol composition, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

68. A use of a peptide in the manufacture of a medicament for improving hearing in an animal, wherein the animal has middle and/or inner ear inflammation and reduced hearing, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus, wherein the medicament is a topical medicament.

69. A use of a peptide in the manufacture of a medicament for treating middle and/or inner ear inflammation, wherein the medicament is suitable for administration to a tympanic membrane of an animal in need or want thereof, the peptide comprising:

a) a sequence of any one of SEQ ID NOS: 187-369; or

b) a derivative of P13 comprising at least one D-amino acid residue,

wherein the peptide optionally further comprises a transducing sequence at the C-terminus.

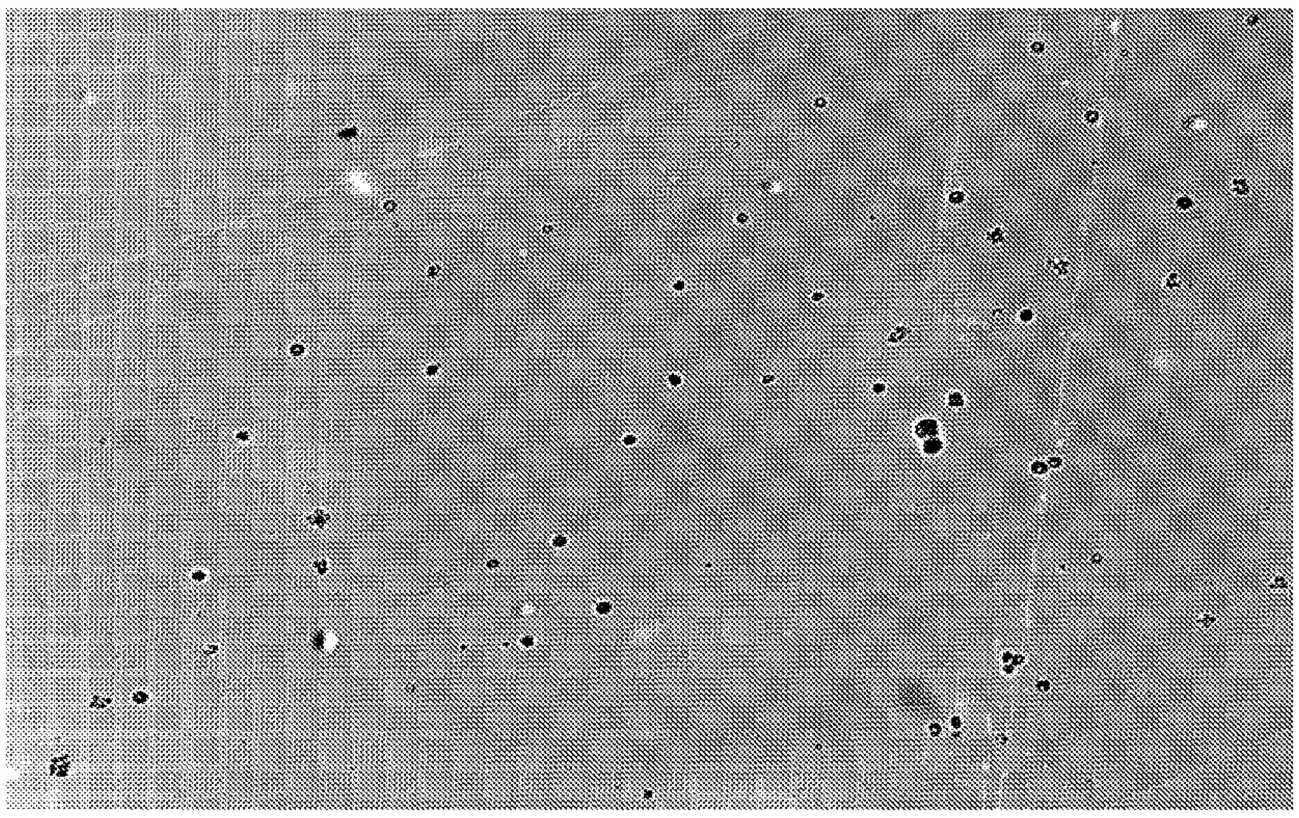


FIGURE 1A

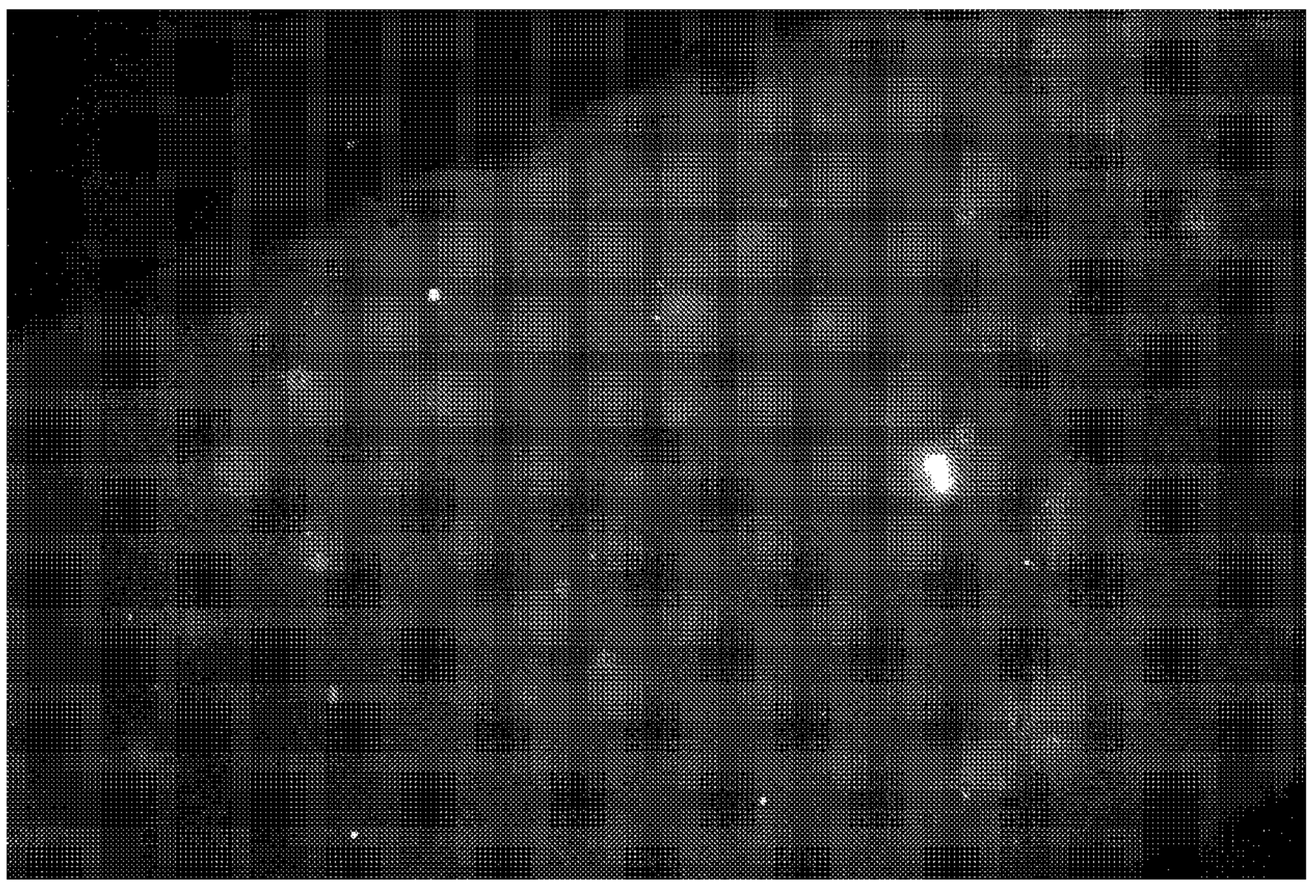
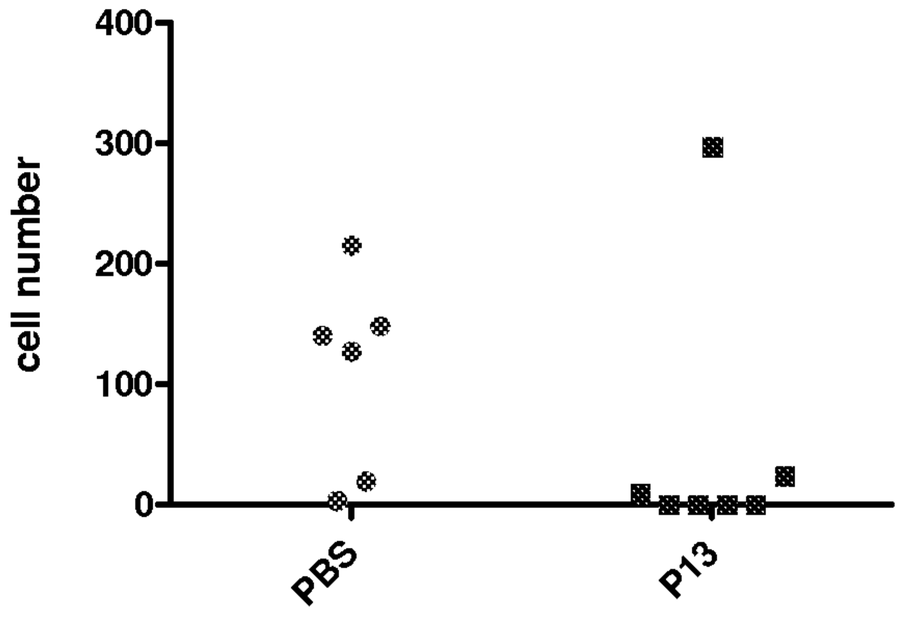


FIGURE 1B


Cell Number
cell number
400
300
200
100
0
PBS
P13

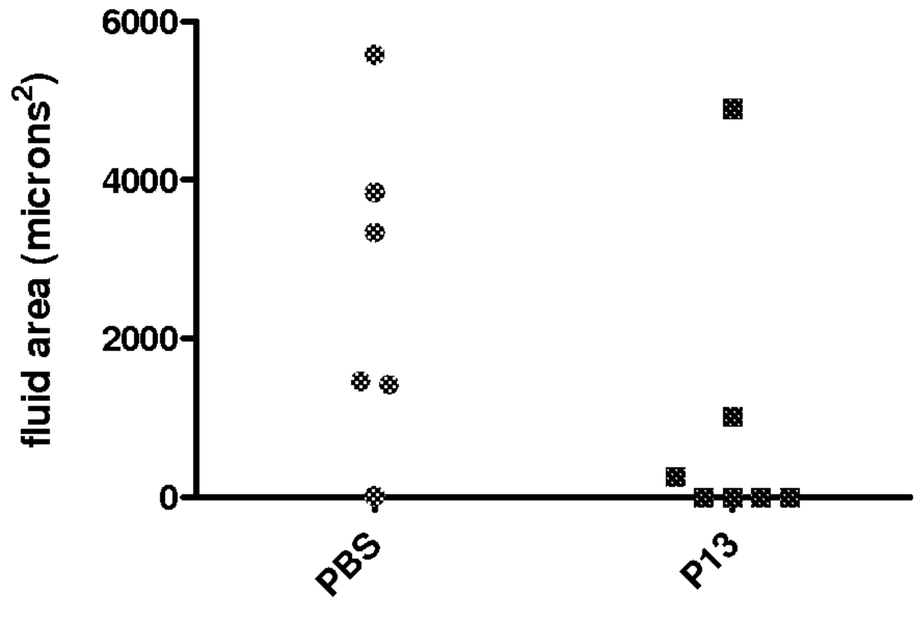
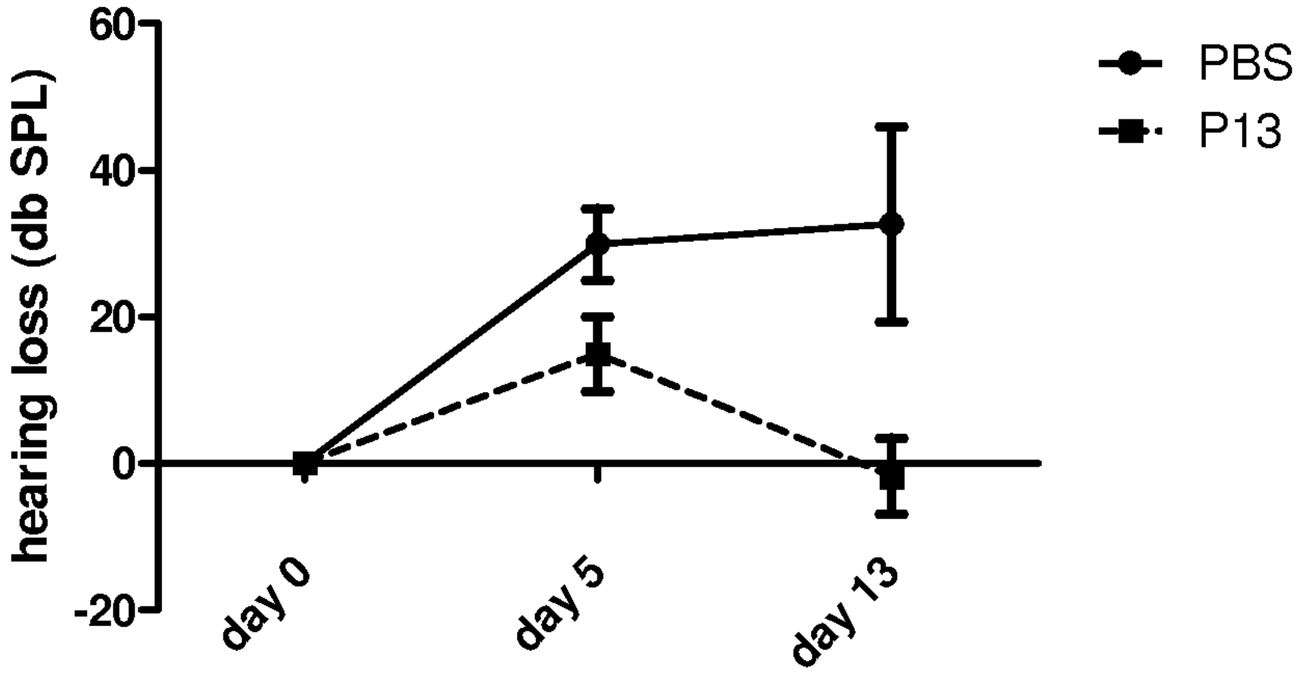

Fluid Area
fluid area (microns2)
6000
4000
2000
0
PBS
P13

FIGURE 2

Panel A: Hearing thresholds

Sum of all frequencies



Panel B: Number of animals with hearing loss

	Day 5	Day 13
PBS	75% (6/8)	63% (5/8)
P13	25% (2/8)	13% (1/8)

FIGURE 3

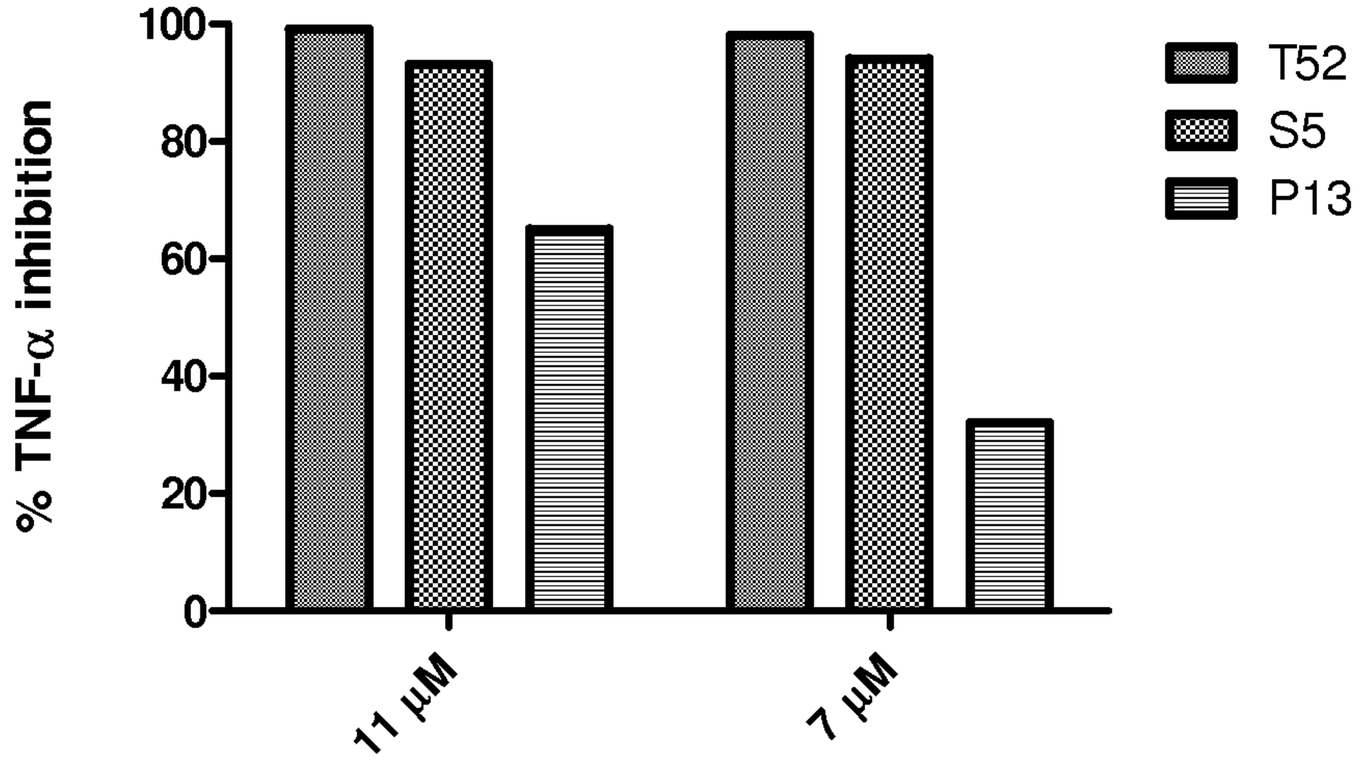


FIGURE 4

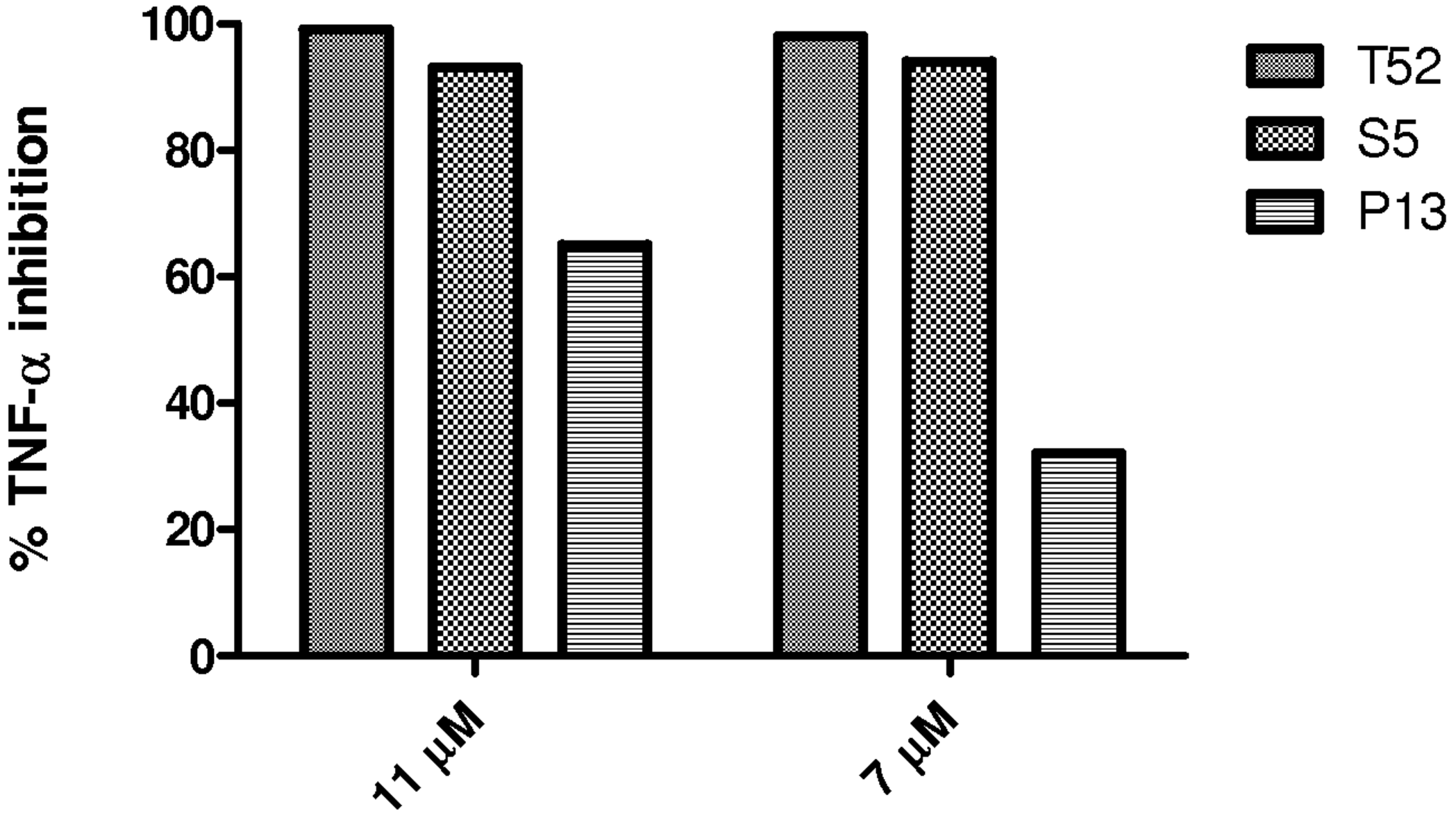


FIGURE 4