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SUMMARY

The present disclosure is directed to individual peptide immunogen constructs targeting portions of the Interleukin-31 (IL-31) protein for the treatment and/or prevention of a pruritic
15 condition and/or an allergic condition, such as atopic dermatitis. The present disclosure is also directed to compositions containing the peptide immunogen constructs, methods of making and using the peptide immunogen constructs, and antibodies produced by the peptide immunogen constructs.

In one aspect, the present disclosure refers to an IL-31 peptide immunogen construct can
20 be represented by the formulae: (Th) m –(A) n –(IL-31 fragment)–X or (IL-31 fragment)–(A) n –(Th) m –X wherein Th is a heterologous T helper epitope, wherein the T helper epitope is selected from the group consisting of SEQ ID NOs: 25 and 27; A is a heterologous spacer; (IL-31 fragment) is a B cell epitope having 15 to 75 amino acid residues from SEQ ID NO: 1 or SEQ ID NO: 2, wherein the IL-31 fragment is selected from the group consisting of SEQ ID NOs: 3-
25 13 and 93-96; X is an α -COOH or α -CONH₂ of an amino acid; m is from 1 to 4; and n is from 0 to 10.

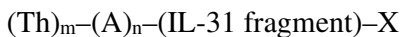
In another aspect, the present disclosure refers to an IL-31 peptide immunogen construct comprising: a B cell epitope comprising 15 to 75 amino acid residues from the full-length IL-31 protein sequence of SEQ ID NO: 1 or SEQ ID NO: 2, wherein the B cell epitope is selected
30 from the group consisting of SEQ ID NOs: 3-13 and 93-96; a T helper epitope comprising an amino acid sequence selected from the group consisting of SEQ ID NOs: 25 and 27; and an optional heterologous spacer selected from the group consisting of an amino acid, Lys-, Gly-, Lys-Lys-Lys-, (α , ϵ -N)Lys, and ϵ -N-Lys-Lys-Lys-Lys (SEQ ID NO: 91), wherein the B cell epitope is covalently linked to the T helper epitope directly or through the optional heterologous
35 spacer.

In yet another aspect, the present disclosure refers to a composition comprising a peptide immunogen construct as disclosed herein.

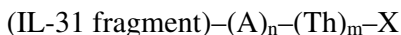
In yet another aspect, the present disclosure refers to a pharmaceutical composition comprising: a. a peptide immunogen construct as disclosed herein; and b. a pharmaceutically
40 acceptable delivery vehicle and/or adjuvant.

CLAIMS

1. An IL-31 peptide immunogen construct can be represented by the formulae:



or



wherein

Th is a heterologous T helper epitope, wherein the T helper epitope is selected from the group consisting of SEQ ID NOs: 25 and 27;

A is a heterologous spacer;

(IL-31 fragment) is a B cell epitope having 15 to 75 amino acid residues from SEQ ID NO: 1 or SEQ ID NO: 2, wherein the IL-31 fragment is selected from the group consisting of SEQ ID NOs: 3-13 and 93-96;

X is an α -COOH or α -CONH₂ of an amino acid;

m is from 1 to 4; and

n is from 0 to 10.

2. The IL-31 peptide immunogen construct according to claim 1, wherein the IL-31 peptide immunogen construct is selected from the group consisting of SEQ ID NOs: 43-90 and 99-103.

3. An IL-31 peptide immunogen construct comprising:

a B cell epitope comprising 15 to 75 amino acid residues from the full-length IL-31 protein sequence of SEQ ID NO: 1 or SEQ ID NO: 2, wherein the B cell epitope is selected from the group consisting of SEQ ID NOs: 3-13 and 93-96;

a T helper epitope comprising an amino acid sequence selected from the group consisting of SEQ ID NOs: 25 and 27; and

an optional heterologous spacer selected from the group consisting of an amino acid, Lys-, Gly-, Lys-Lys-Lys-, (α , ϵ -N)Lys, and ϵ -N-Lys-Lys-Lys-Lys (SEQ ID NO: 91),

wherein the B cell epitope is covalently linked to the T helper epitope directly or through the optional heterologous spacer.

4. The IL-31 peptide immunogen construct of claim 3, wherein the optional heterologous spacer is (α , ϵ -N)Lys or ϵ -N-Lys-Lys-Lys-Lys (SEQ ID NO: 91).
5. The IL-31 peptide immunogen construct of claim 3, wherein the T helper epitope is covalently linked to the amino terminus of the B cell epitope.
6. The IL-31 peptide immunogen construct of claim 3, wherein the T helper epitope is covalently linked to the amino terminus of the B cell epitope through the optional heterologous spacer.
7. A composition comprising a peptide immunogen construct according to any of claims 1 to 2.
8. A pharmaceutical composition comprising:
 - a. a peptide immunogen construct according to any of claims 1 to 2; and
 - b. a pharmaceutically acceptable delivery vehicle and/or adjuvant.
9. The pharmaceutical composition of claim 8, wherein
 - a. the IL-31 peptide immunogen construct is selected from the group consisting of SEQ ID NOs: 43-90 and 99-103; and
 - b. the IL-31 peptide immunogen construct is mixed with a CpG oligodeoxynucleotide (ODN) to form a stabilized immunostimulatory complex.