CLAIMS

1. Fusion protein having formula (I)

$$X_1–Y–X_2 \text{ (I)},$$

in which X_1 and X_2 comprise each four to eight allergen fragments fused to each other, in which the allergen fragments are derived from at least two allergens of *Dermatophagoides pteronyssinus* selected from the group consisting of Der p 1, Der p 2, Der p 5, Der p 7, Der p 21 and Der p 23, and in which Y is a carrier protein, in which:

(a) the allergen fragment of Der p 1 consists of an amino acid sequence selected from the group consisting of TNACSINGNAPAEIDLRQMRTVTPIRMQGGCGSCWAFSGVA (SEQ ID No. 1), ATESAYLAYRNQSLDLAEQELVDCASQHGCHGDTIPRGIEYIQ (SEQ ID No. 2), HNGVVQESYYRYVAREQSCRRPNAQRFGISN (SEQ ID No. 3), VRNSWDTNWGDNGYGYFAANIDLMMIEEYPYVVIL (SEQ ID No. 4), TNASSINGNAPAEIDLRQMRTVTPIRMQGGSGSSWAFSGVA (SEQ ID No. 5), ATESAYLAYRNQSLDLAEQELVDSASQHGSHGDTIPRGIEYIQ (SEQ ID No. 6) and HNGVVQESYYRYVAREQSSRRPNAQRFGISN (SEQ ID No. 7), and/or

(b) the allergen fragment of Der p 2 consists of an amino acid sequence selected from the group consisting of CHGSEPCIIHRGKPFQLEAVFEANQNSKTAK (SEQ ID No. 8), EVDVPGIDPNACHYMKCPLVKGQQYDIKYTWIVPKIAPKSEN (SEQ ID No. 9), HGSEPSIIHRGKPFQLEAVFEANQNSKTAK (SEQ ID No. 10) and EVDVPGIDPNASHYMKSPLVKGQQYDIKYTWIVPKIAPKSEN (SEQ ID No. 11), and/or

(c) the allergen fragment of Der p 5 consists of an amino acid sequence selected from the group consisting of DYQNEFDFLLMERIHEQIKKGELALFYLQ (SEQ ID No. 12) and EQYNLEMAKKSGDILERDLKKEEARVKKIEV (SEQ ID No. 13), and/or

(d) the allergen fragment of Der p 7 consists of amino acid sequence DPIHYDKITEEINKAVDEAVAAIEKSETFD (SEQ ID No. 14), and/or

(e) the allergen fragment of Der p 21 consists of amino acid sequence YNYEFALESIKLLIKKLDELAKKVKAVNPDEYY (SEQ ID No. 15), and/or

(f) the allergen fragment of Der p 23 consists of an amino acid sequence selected from the group consisting of GYFADPKDPHKFYICSNWEAVHKDCPGNTRWNEDEETCT (SEQ ID No. 16) and GYFADPKDPHKFYISSNWEAVHKDSPGNTRWNEDEETST (SEQ ID No. 17).

2. A fusion protein according to Claim 1, in which the allergen fragments of the at least two allergens consist of 25 to 50 amino acid residues, preferably 28 to 48 amino acid residues, more preferably 30 to 45 amino acid residues.

3. A fusion protein according to Claim 1 or 2, in which at least one, preferably at least two, more preferably at least three, in particular all, of the cysteine residues of the allergen fragments are substituted with serine, threonine, glycine, alanine, or leucine.

4. A fusion protein according to Claims 1, 2 or 3, in which X1 and X2 comprise further:

(g) an allergen fragment of Der f 1 consisting of an amino acid sequence selected from the group consisting of TSACRINSVNVPSELDLRSLRTVTPIRMQGGCGSCWAFSGVA (SEQ ID No. 38), ATESAYLAYRNTSLDLSEQELVDCASQHGCHGDTIPRGIEYIQ (SEQ ID No. 39), QNGVVEERSYPYVAREQQCRRPNSQHYGISN (SEQ ID No. 40) and VRNSWDTTWGDSGYGYFQAGNNLMMIEQYPYVVIM (SEQ ID No. 41), and/or

(h) an allergen fragment of Der f 2 consisting of an amino acid sequence selected from the group consisting of HGSDPCIIHRGKPFNLEAIFDANQNTKTAK (SEQ ID No. 42) and EVDVPGIDTNACHYIKCPLVKGQQYDAKYTWNVPKIAPKSEN (SEQ ID No. 43), and/or

(i) an allergen fragment of Der f 5 consisting of an amino acid sequence selected from the group consisting of DYQNEFDFLLMQRIHEQMRKGEEALLHLQ (SEQ ID No. 44) and ERYNVEIALKSNEILERDLKKEEQRVKKIEV (SEQ ID No. 45), and/or

(j) an allergen fragment of Der f 7 consisting of amino acid sequence DPIHYDKITEEINKAIDDAIAAIEQSETID (SEQ ID No. 46), and/or

(k) an allergen fragment of Der f 21 consisting of amino acid sequence YNFETAVSTIEILVKDLAELAKKVKAVKSDD (SEQ ID No. 47), and/or

(l) an allergen fragment of Der f 23 consisting of amino acid sequence GYFADPKDPCKFYICSNWEAIHKSCPGNTRWNEKELTCT (SEQ ID No. 48)

5. A fusion protein according to any preceding claim, in which the fusion protein comprises at least one polypeptide having amino acid sequence selected from the group consisting of SEQ ID No. 18, SEQ ID No. 19, SEQ ID No. 20, SEQ ID No. 21, SEQ ID No. 22, SEQ ID No. 23, SEQ ID No. 24 and/or SEQ ID No. 25.

6. A fusion protein according to any preceding claim, in which the carrier protein is a surface polypeptide of a virus of a hepadnaviridae family or a fragment of the surface polypeptide.

7. A fusion protein according to any preceding claim, in which the fusion protein comprises amino acid sequence SEQ ID No. 27 or amino acid sequence SEQ ID No. 28.

8. A nucleic acid molecule encoding a fusion protein according to any preceding claim.

9. A vector comprising a nucleic acid molecule according to Claim 8.

10. A host cell comprising a nucleic acid molecule according to Claim 8 or a vector according to Claim 9.

11. A pharmaceutical preparation comprising at least one fusion protein according to any of Claims 1 to 7 or at least one nucleic acid molecule according to Claim 8.

12. A pharmaceutical preparation according to Claim 11, in which two fusion proteins or nucleic acid molecules comprised in the preparation have a weight ratio of 1:10 to 10:1, preferably of 1:5 to 5:1, more preferably of 2:1 to 1:2, more preferably of 1:1.

13. A pharmaceutical preparation according to Claim 11 or 12, in which the preparation comprises a fusion protein comprising amino acid sequence SEQ ID No. 27 and/or a fusion protein comprising amino acid sequence SEQ ID No. 28 or a nucleic acid molecule encoding a fusion protein comprising amino acid sequence SEQ ID No. 27 and/or a fusion protein comprising amino acid sequence SEQ ID No. 28.

14. A fusion protein according to any of Claims 1 to 7, a nucleic acid molecule according to Claim 8 or a pharmaceutical preparation according to any of Claims 11 to 13 for the use in the treatment or the prevention of an allergy caused by an allergen of a house dust mite.

CLAIMS

1. A fusion protein having formula (I)

$$X_1–Y–X_2 \text{ (I)},$$

in which X_1 and X_2 comprise each four to eight allergen fragments or variants thereof fused to each other, in which the allergen fragments are derived from at least two allergens of *Dermatophagoides pteronyssinus* selected from the group consisting of Der p 1, Der p 2, Der p 5, Der p 7, Der p 21 and Der p 23, and in which Y is a carrier protein, in which the fusion protein comprises at least one polypeptide having amino acid sequence selected from the group consisting of SEQ ID No. 18, SEQ ID No. 19, SEQ ID No. 20, SEQ ID No. 21, SEQ ID No. 22, SEQ ID No. 23, SEQ ID No. 24 and/or SEQ ID No. 25, in which:

(a) the allergen fragment of Der p 1 consists of an amino acid sequence selected from the group consisting of TNACSINGNAPAEIDLRQMRTVTPIRMQGGCGSCWAFSGVA (SEQ ID No. 1), ATESAYLAYRNQSLDLAEQELVDCASQHGCHGDTIPRGIEYIQ (SEQ ID No. 2), HNGVVQESYYRYVAREQSCRRPNAQRFGISN (SEQ ID No. 3), VRNSWDTNWGDNGYGYFAANIDLMMIEEYPYVVIL (SEQ ID No. 4), TNASSINGNAPAEIDLRQMRTVTPIRMQGGSGSSWAFSGVA (SEQ ID No. 5), ATESAYLAYRNQSLDLAEQELVDSASQHGSHGDTIPRGIEYIQ (SEQ ID No. 6) and HNGVVQESYYRYVAREQSSRRPNAQRFGISN (SEQ ID No. 7), and/or

(b) the allergen fragment of Der p 2 consists of an amino acid sequence selected from the group consisting of CHGSEPCIIHRGKPFQLEAVFEANQNSKTAK (SEQ ID No. 8), EVDVPGIDPNACHYMKCPLVKGQQYDIKYTWIVPKIAPKSEN (SEQ ID No. 9), HGSEPSIIHRGKPFQLEAVFEANQNSKTAK (SEQ ID No. 10) and EVDVPGIDPNASHYMKSPLVKGQQYDIKYTWIVPKIAPKSEN (SEQ ID No. 11), and/or

(c) the allergen fragment of Der p 5 consists of an amino acid sequence selected from the group consisting of DYQNEFDFLLMERIHEQIKKGELALFYLQ (SEQ ID No. 12) and EQYNLEMAKKSGDILERDLKKEEARVKKIEV (SEQ ID No. 13), and/or

(d) the allergen fragment of Der p 7 consists of amino acid sequence DPIHYDKITEEINKAVDEAVAAIEKSETFD (SEQ ID No. 14), and/or

(e) the allergen fragment of Der p 21 consists of amino acid sequence YNYEFALESIKLLIKKLDELAKKVKAVNPDEYY (SEQ ID No. 15), and/or

(f) the allergen fragment of Der p 23 consists of an amino acid sequence selected from the group consisting of GYFADPKDPHKFYICSNWEAVHKDCPGNTRWNEDEETCT (SEQ ID No. 16) and GYFADPKDPHKFYISSNWEAVHKDSPGNTRWNEDEETST (SEQ ID No. 17), and/or

(g) the allergen fragment of Der f 1 consists of an amino acid sequence selected from the group consisting of TSACRINSVNVPSELDLRSLRTVTPIRMQGGCGSCWAFSGVA (SEQ ID No. 38), ATESAYLAYRNTSLDLSEQELVDCASQHGCHGDTIPRGIEYIQ (SEQ ID No. 39), QNGVVEERSYPYVAREQQCRRPNSQHYGISN (SEQ ID No. 40) and VRNSWDTTWGDSGYGYFQAGNNLMMIEQYPYVVIM (SEQ ID No. 41), and/or

(h) the allergen fragment of Der f 2 consists of an amino acid sequence selected from the group consisting of HGSDPCIIHRGKPFNLEAIFDANQNTKTAK (SEQ ID No. 42) and EVDVPGIDTNACHYIKCPLVKGQQYDAKYTWNVPKIAPKSEN (SEQ ID No. 43), and/or

(i) the allergen fragment of Der f 5 consists of an amino acid sequence selected from the group consisting of DYQNEFDFLLMQRIHEQMRKGEEALLHLQ (SEQ ID No. 44) and ERYNVEIALKSNEILERDLKKEEQRVKKIEV (SEQ ID No. 45), and/or

(j) the allergen fragment of Der f 7 consists of an amino acid sequence DPIHYDKITEEINKAIDDAIAAIEQSETID (SEQ ID No. 46), and/or

(k) the allergen fragment of Der f 21 consists of an amino acid sequence being at least 90% identical to amino acid sequence YNFETAVSTIEILVKDLAELAKKVKAVKSDD (SEQ ID No. 47), and/or

(l) the allergen fragment of Der f 23 consists of an amino acid sequence GYFADPKDPCKFYICSNWEAIHKSCPGNTRWNEKELTCT (SEQ ID No. 48).

2. A fusion protein according to Claim 1, in which the allergen fragments of the at least two allergens consist of 25 to 50 amino acid residues.

3. A fusion protein according to Claim 1, in which the allergen fragments of the at least two allergens consist of 28 to 48 amino acid residues.

4. A fusion protein according to Claim 1, in which the allergen fragments of the at least two allergens consist of 30 to 45 amino acid residues.

5. A fusion protein according to any preceding claim, in which at least one of the cysteine residues of the allergen fragments are substituted with serine, threonine, glycine, alanine, or leucine.

6. A fusion protein according to Claim 1, in which the carrier protein is a surface polypeptide of a virus of a hepadnaviridae family or a fragment of the surface polypeptide.

7. A fusion protein according to any preceding claim, in which the fusion protein comprises amino acid sequence SEQ ID No. 27 or amino acid sequence SEQ ID No. 28.

8. A nucleic acid molecule encoding a fusion protein according to any preceding claim.

9. A vector comprising a nucleic acid molecule according to Claim 8.

10. A host cell comprising a nucleic acid molecule according to Claim 8 or a vector according to Claim 9.

11. A pharmaceutical preparation comprising at least one fusion protein according to any of Claims 1 to 7 or at least one nucleic acid molecule according to Claim 8.

12. A pharmaceutical preparation according to Claim 11, in which two fusion proteins or nucleic acid molecules comprised in the preparation have a weight ratio of 1:10 to 10:1.

13. A pharmaceutical preparation according to Claim 11 or 12, in which the preparation comprises a fusion protein comprising amino acid sequence SEQ ID No. 27 and/or a fusion protein comprising amino acid sequence SEQ ID No. 28 or a nucleic acid molecule encoding a fusion protein comprising amino acid sequence SEQ ID No. 27 and/or a fusion protein comprising amino acid sequence SEQ ID No. 28.

14. A fusion protein according to any of Claims 1 to 7, a nucleic acid molecule according to Claim 8 or a pharmaceutical preparation according to any of Claims 11 to 13 for use in the treatment or prevention of an allergy caused by an allergen of a house dust mite.