CLAIMS

1. A virus-like particle comprising:
- an envelope consisting of a plasma membrane of which at least one portion is typical of lipid rafts; and
- at least one type I or II transmembrane fusion protein anchored in said membrane, said fusion protein comprising the following fragments, successively:
b) a protein or a peptide of interest;
c) a coiled-coil domain or oligomerization sequence, which does not originate from a virus; and
d) a domain for anchoring in the plasma membrane, consisting of a transmembrane segment and a cytosolic segment, preferably a domain for anchoring in a plasma membrane of which at least one portion is typical of lipid rafts,
fragments b) and c) being exposed at the surface of the virus-like particle,
wherein said protein or peptide of interest is selected from the group consisting of allergens and immunogenic fragments thereof, cell surface proteins and immunogenic fragments thereof, proteins and peptides that are accumulated in chronic or neurodegenerative diseases, proteins and peptides involved in hypertension, immunoglobulins and immunogenic fragments thereof, cytokines and immunogenic fragments thereof, and hormones and immunogenic fragments thereof.

2. The virus-like particle according to claim 1, wherein said protein or peptide of interest is chosen from allergens and immunogenic fragments thereof.

3. The virus-like particle according to claim 1 or 2, wherein a linker is present between fragments b) and c), and/or between fragments c) and d).

4. The virus-like particle according to any one of claims 1 to 3, wherein:
c) the coiled-coil domain is chosen from SEQ ID NO: 24, SEQ ID NO: 27, SEQ ID NO: 28, SEQ ID NO: 29, SEQ ID NO: 33 and SEQ ID NO: 30; and
d) the anchoring domain is chosen from the anchoring sequence of the H5N1 influenza virus H5 hemagglutinin (SEQ ID NO: 26) and the anchoring sequence of the PDLP1 protein (SEQ ID NO: 31).

5. A type I or type II transmembrane fusion protein comprising the following fragments, successively:
a) optionally, a signal peptide;
b) a protein or a peptide of interest;
c) a coiled-coil domain or oligomerization sequence, which does not originate from a virus; and
d) a domain for anchoring in the plasma membrane, consisting of a transmembrane segment and a cytosolic segment, preferably a domain for anchoring in a plasma membrane of which at least one portion is typical of lipid rafts,
wherein said protein or peptide of interest is selected from the group consisting of allergens and immunogenic fragments thereof, cell surface proteins and immunogenic fragments thereof, proteins and peptides that are accumulated in chronic or neurodegenerative diseases, proteins and peptides involved in hypertension, immunoglobulins and immunogenic fragments thereof, cytokines and immunogenic fragments thereof, and hormones and immunogenic fragments thereof.

6. A nucleic acid encoding a fusion protein as claimed in claim 5.

7. A host cell or a vector comprising at least one nucleic acid according to claim 6.

8. The virus-like particle according to any one of claims 1 to 4, for use in therapy.

9. The virus-like particle according to any one of claims 1 to 4, for use in allergen immunotherapy, wherein said protein or peptide of interest is selected from allergens and immunogenic fragments thereof.

10. A method for producing virus-like particles according to any one of claims 1 to 4, comprising the expression of the nucleic acid as claimed in claim 6 in eukaryotic cells.

11. The method according to claim 10, characterized in that the eukaryotic cells are plant cells, and in that it comprises the following steps:

a) transformation of agrobacteria with an expression vector comprising a nucleic acid according to claim 6 functionally linked to a strong promoter; and

b) transfection of the plant cells with the agrobacteria obtained in step a), said transfection comprising the following steps:

b1) culture of the plant cells, under aeroponic or hydroponic conditions, and under LED lighting, preferably for four to six weeks under hydroponic conditions,

b2) agroinfiltration of the plant cells obtained in b1) under vacuum, with the agrobacteria obtained in step a), preferably carried out under vacuum by Venturi effect,

b3) return to culture of the plant cells obtained in b2), typically for 3 to 6 days, in order to obtain the virus-like particles,

then extraction of the virus-like particles obtained and purification, in particular by enzymatic extraction.