CLAIMS

1. A method of producing a picornavirus-like particle (PVLP) in a plant, a portion of a plant, or a plant cell comprising:

a) introducing a first nucleic acid and a second nucleic acid into the plant, portion of the plant, or the plant cell, the first nucleic acid comprising a first regulatory region active in the plant operatively linked to a first nucleotide sequence encoding a picornavirus polyprotein comprising P1 and the second nucleic acid comprising a second regulatory region active in the plant and operatively linked to a second nucleotide sequence encoding one or more than one picornavirus 3C or 3CD protease;

b) incubating the plant, portion of the plant, or plant cell under conditions that permit the expression of the first and second nucleic acids to produce a picornavirus polyprotein and the one or more than one picornavirus 3C or 3CD protease, the picornavirus polyprotein being processed into structural proteins VP1, VP3 and VP0, or VP1, VP2, VP3 and VP4, thereby producing the PVLP; and

c) harvesting the plant, the portion of the plant, or plant cell and purifying the PVLPs.

2. The method of claim 1, wherein the ratio of introduced amounts of the first nucleic acid relative to the second nucleic acid is between 20:1 and 0.5:1.

3. The method of claim 1, wherein the first nucleotide sequence encoding the picornavirus polyprotein is derived from the group of Aphthovirus, Avihepatovirus, Cardiovirus, Enterovirus, Erbovirus, Hepatovirus, Kobuvirus, Parechovirus, Sapelovirus, Senecavirus, Teschovirus and Tremovirus.

4. The method of claim 1, wherein the first nucleotide sequence encoding the picornavirus polyprotein is derived from Enterovirus 71 or poliovirus.

5. The method of claim 1, wherein in the step of introducing (step a), the nucleic acid is transiently expressed in the plant.

6. The method of claim 1, wherein, in the step of introducing (step a), the nucleic acid is stably expressed in the plant.

7. A method of producing a Picornavirus-like particle (PVLP) in a plant, portion of a plant or plant cell comprising:

a) providing the plant, portion of the plant or plant cell comprising a first nucleic acid comprising a first regulatory region active in the plant operatively linked to a first nucleotide sequence encoding a picornavirus polyprotein P1 and a second nucleic acid comprising a second regulatory region active in the plant operatively linked to a second nucleotide sequence encoding one or more than one picornavirus 3C or 3CD protease;

b) incubating the plant, portion of the plant or plant cell under conditions that permit the expression of the nucleic acids to produce the picornavirus polyprotein and the one or more than

one picornavirus 3C or 3CD protease, the picornavirus polyprotein being processed into structural proteins VP1, VP3 and VP0, or VP1, VP2, VP3 and VP4, thereby producing the PVLP and,

c) harvesting the plant, the portion of the plant, or plant cell and purifying the PVLPs.

8. The method of claim 7, wherein the first nucleotide sequence encoding the picornavirus polyprotein is derived from the group of Aphthovirus, Avihepatovirus, Cardiovirus, Enterovirus, Erbovirus, Hepatovirus, Kobuvirus, Parechovirus, Sapelovirus, Senecavirus, Teschovirus and Tremovirus.

9. The method of claim 7, wherein the first nucleotide sequence encoding the picornavirus polyprotein is derived from Enterovirus 71 or poliovirus.

10. The method of claims 1 or 7, wherein the first nucleic acid sequence comprises the first regulatory region operatively linked with one or more than one comovirus enhancer, the nucleotide sequence encoding the polyprotein, and one or more than one amplification element, and a third nucleic acid encoding a replicase is introduced into the plant or portion of the plant.

11. The method of claims 1 or 7, wherein the second nucleic acid does not comprise one or more than one amplification element or one or more comovirus enhancer.

12. A plant extract comprising a first nucleic acid and a second nucleic acid, the first nucleic acid comprising a first regulatory region active in the plant cell operatively linked to a first nucleotide sequence encoding picornavirus structural proteins VP1, VP3, and VP0 or picornavirus structural proteins VP1, VP2, VP3, and VP4 and the second nucleic acid comprising a second regulatory region active in the plant cell and operatively linked to a second nucleotide sequence encoding one or more than one picornavirus 3C or 3CD protease.

13. The plant extract of claim 12, wherein the picornavirus polyprotein is selected from the group of Aphthovirus polyprotein, Avihepatovirus polyprotein, Cardiovirus polyprotein, Enterovirus polyprotein, Erbovirus polyprotein, Hepatovirus polyprotein, Kobuvirus polyprotein, Parechovirus polyprotein, Sapelovirus polyprotein, Senecavirus polyprotein, Teschovirus polyprotein, and Tremovirus polyprotein.

14. The plant extract of claim 12, wherein the picornavirus polyprotein is a Enterovirus 71 polyprotein or a poliovirus polyprotein.

15. A composition comprising the plant extract of claim 13, for use in inducing an immune response against picornavirus in a subject and a pharmaceutically acceptable carrier.

16. The composition of claim 15, wherein the plant extract is administered to a subject orally, intradermally, intranasally, intramuscularly, intraperitoneally, intravenously, or subcutaneously.

17. A plant cell comprising a first nucleic acid and a second nucleic acid, the first nucleic acid comprising a first regulatory region active in the plant cell and operatively linked to a first nucleotide sequence encoding picornavirus structural proteins VP1, VP3, and VP0 or picornavirus structural proteins VP1, VP2, VP3, and VP4, the first regulatory region comprising

a first enhancer element, and the second nucleic acid comprising a second regulatory region active in the plant cell and operatively linked to a second nucleotide sequence encoding one or more than one picornavirus 3C or 3CD protease, the second regulatory region comprising a second enhancer element.

18. The plant cell of claim 17, wherein the picornavirus structural proteins are selected from the group of Aphthovirus structural proteins, Avihepatovirus structural proteins, Cardiovirus structural proteins, Enterovirus structural proteins, Erbovirus structural proteins, Hepatovirus structural proteins, Kobuvirus structural proteins, Parechovirus structural proteins, Sapelovirus structural proteins, Senecavirus structural proteins, Teschovirus structural proteins, and Tremovirus structural proteins.

19. The plant cell of claim 17, wherein the picornavirus structural proteins are Enterovirus 71 structural proteins or poliovirus structural proteins.