proteins, or suprastructure proteins, digesting the plant matter using a cell wall degrading enzyme composition to produced a digested fraction, and filtering the digested fraction to produced a filtered fraction and recovering the plant-derived proteins, or suprastructure proteins, from the filtered fraction.

[0025] The enzyme composition may comprise one or more than one pectinase, one or more than one cellulose, or one or more than one pectinase and one or more than one cellulase. Furthermore, if desired, the enzyme composition does not include a lipase or protease, or the composition does not include an added lipase or protease. The plant-derived suprastructure protein may be a chimeric plant-derived suprastructure protein. The plant derived protein suprastructure may include a protein rosette, a protein complex, a proteasome, a metabolon, a transcription complex, a recombination complex, a photosynthetic complex, a membrane transport complex, a nuclear pore complex, a protein nanoparticle, a glycoprotein, an antibody, a polyclonal antibody, a monoclonal antibody, a single chain monoclonal antibody, a virus like particle, a viral envelope protein, a viral structural protein, a viral capsid protein, and a viral coat protein, a chimeric protein, a chimeric protein complex, a chimeric protein nanoparticle, a chimeric glycoprotein, a chimeric antibody, a chimeric monoclonal antibody, a chimeric single chain monoclonal antibody, a chimeric hemagglutinin, a viral envelope protein, a viral structural protein, a viral capsid protein, and a viral coat protein. The plant derived monoclonal antibody may comprise a chimeric mouse human monoclonal antibody, for example but not limited to C2B8. The plant derived VLPs may comprise influenza hemagglutinin.

[0026] The present invention provides a method of preparing plant derived proteins, or suprastructure proteins, as described above (Method B), wherein a nucleic acid encoding the proteins, or suprastructure proteins, is introduced into the plant in a transient manner. Alternatively, the nucleic acid is stably integrated within a genome of the plant.

[0027] The present invention provides a method of preparing plant derived VLPs as described above (Method B) further comprising a step of separating the proteins, or suprastructure proteins, in the filtered fraction from the cellular debris and insoluble materials. The step of separating may be performed by centrifugation, by depth filtration, or bother centrifugation and depth filtration to produce a clarified fraction. The plant derived proteins, or suprastructure proteins, may be further purified by chromatography, for example, the clarified extract may be purified

[0073] Another parameter to set for the plant digestion is the temperature. Temperature may be controlled if desired during the digestion process. Useful temperature range should be between 4°C and 40 °C or any temperature therebetween, for example from about 4°C to about 15°C, or any amount therebetween, or from about 4°C to about 22°C, or any temperature therebetween. Depending to the temperature chosen, the other digestion experimental parameters may be adjusted to maintain optimal extraction conditions.

[0074] Cations, salts or both may be added to improve plasma membrane stability, for example divalent cations, such as Ca^{2+}, or Mg^{2+}, at 0.5-50mM, or any amount therebetween, salts, for example $CaCl_2$, NaCl, $CuSO_4$, KNO_3, and the like, from about 0 to about 750 mM, or any amount therebetween, for example 10, 20, 30, 40, 50, 100, 200, 300, 400, 500, 600, 700 or 750 mM. Other additives may also be added including a chelator for example, but not limited to, EDTA, EGTA, from about 0 to about 200 mM, or any amount therebetween, for example 5, 10, 15, 20, 25, 50, 75, 100, 125, 150, 175, 200 mM, or any amount therebetween, a reducing agent to prevent oxidation such as, but not limited to, sodium bisulfite or ascorbic acid, at 0.005-0.4% or any amount therebetween, for example 0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.07, 0.08, 0.09, 0.1, 0.15, 0.2, 0,25, 0.3, 0.35, 0.4%, or any amount therebetween, specific enzyme inhibitors (see below), and if desired, an inhibitor of foliar senescence, for example, cycloheximide, kinetin, or one or more polyamines.

[0075] The digestion solution may also comprise one or more of mannitol from about 0 to about 600 mM, NaCl from about 0 to about 500 mM, EDTA from about 0 to about 50 mM, cellulose from about 1% to about 2% v/v, pectinase from about 0 to about 1% v/v, sodium metabisulfite from about 0.03 to about 0.04%, citrate from about 0 to about 125 mM or $NaPO_4$ from about 0 to 75 mM.

[0076] The plant matter may be treated to enhance access of the enzymes or enzyme composition to the plant cell wall. For example, the epidermis of the leaf may be removed or 'peeled' before treatment with an enzyme composition. The plant matter may be cut into small pieces (manually, or with a shredding or cutting device such as an Urschel slicer); the cut up plant matter may be further infiltrated with an enzyme composition under a partial vacuum (Nishimura and Beevers 1978, Plant Physiol 62:40-43; Newell et al., 1998, J. Exp Botany 49:817-827). Mechanical perturbation of the plant matter may also be applied to the plant tissues (Giridhar et al., 1989. Protoplasma 151:151-157) before or during treatment with an enzyme composition.

theory, since Ca^{2+} plays a critical role in the retention of constituents of the cell wall's middle lamellae together, and given the fact that there is usually a high concentration of Ca^{2+} in plant cell wall, the addition of Ca^{2+}-chelator EDTA could facilitate the enzymatic depolymerisation of the cell wall, thereby preserving intact intracellular organelles, such as chloroplasts, and preventing the release green-pigments components.

[00155] As shown in Table 6, the addition of 25mM EDTA to the digestion buffer allowed for the reduction of the green coloration of the purified H5-VLP preparation, as evaluated by measuring the difference in absorption of the preparation (OD_{672nm} - OD_{650nm}). When the green constituents were released in high quantity, or not suitably removed, VLP preparation exhibited a $\Delta OD > 0.040$.

Table 6 : Effect of the addition of 25 mM EDTA to the digestion buffer on green coloration of H5-VLP preparations.

	OD_{672nm} - OD_{650nm}
0 mM NaCl, 0 mM EDTA	**0.071 ± 0.061**
500 mM NaCl	**0.087 ± 0.060**
500 mM NaCl + 25 mM EDTA	**0.010 ± 0.002**

Example 7: Alternative digestion buffer compositions

[00156] *N. benthamiana* plants were agroinfiltrated with *Agrobacterium* AGL1 strains carrying a construct expressing a hemagglutinin of interest (H5/Indo) as described in Example 1. Leaves were collected on day 6 post-infiltration, cut into ~1 cm^2 pieces and digested according to Example 4, with modification of digestion buffer to include 0%, 0.25%, 0.5%, 0.75% or 1% v/v Multifect Pectinase FE, Multifect CX- CG cellulase and Multifect CX B cellulose as noted in Tables 7-9. Filtration, centrifugation and clarification were as described in Example 4.

[00157] As shown in following tables 7 and 8, pectinase has been demonstrated to be non-essential in the digestion buffer. Similar levels of H5/Indo or H1/Cal WT VLP can be extracted with the present method either in the presence or absence of pectinase. Furthermore, it has been

WHAT IS CLAIMED IS:

1. A method of preparing plant derived proteins, or suprastructure proteins, comprising:

   a. obtaining a plant or plant matter comprising apoplast-localized proteins, or suprastructure proteins,

   b. producing a protoplast/spheroplast fraction and an apoplast fraction; and,

   c. recovering the apoplast fraction, the apoplast fraction comprising the plant-derived proteins, or suprastructure proteins.

2. The method of claim 1 wherein in the step or producing (step b), the apoplast and protoplast fractions are produced by treatment of the plant or plant matter by a cell wall degrading enzyme composition.

3. The method of claim 2 wherein the cell wall degrading enzyme composition comprises one or more than one pectinase, one or more than one cellulase, or one or more than one pectinase and one or more than one cellulase.

4. The method of claim 3, wherein the cell wall degrading enzyme composition does not include one or more of a lipase, a protease or a pectinase.

5. The method of claim 1 wherein in the step of obtaining (step a), the plant is transformed with a nucleic acid sequence encoding the proteins, or suprastructure proteins, is selected from the group of a peptide, a protein, a protein rosette, a protein complex, a proteasome, a metabolon, a transcription complex, a recombination complex, a photosynthetic complex, a membrane transport complex, a nuclear pore complex, a protein nanoparticle, a glycoprotein, an antibody, a polyclonal antibody, a monoclonal antibody, a single chain monoclonal antibody, a virus like particle, a viral envelope protein, a viral structural protein, a viral capsid protein, and a viral coat protein, a chimeric protein, a chimeric protein complex, a chimeric protein nanoparticle, a chimeric glycoprotein, a chimeric antibody, a chimeric monoclonal antibody, a chimeric single chain monoclonal antibody, a chimeric hemagglutinin, a viral envelope protein, a viral structural protein, a viral capsid protein, and a viral coat protein, and the plant or plant matter is harvested.

6. The method of claim 5, wherein the nucleic acid is introduced into the plant in a transient manner.

7. The method of claim 5, wherein, the nucleic acid is stably integrated within a genome of the plant.

8. The method of claim 1 wherein in the step of obtaining (step a) , the plant is grown and the plant or plant matter harvested.

9. The method of claim 5 wherein the nucleic acid encodes a monoclonal antibody or an influenza hemagglutinin.

10. The method of claim 1 wherein the plant derived proteins, or suprastructure proteins, do not include neuraminidase or M protein.

11. The method of claim 1 wherein the plant matter is selected from the group of leaves, and cultured plant cells.

12. The method of claim 1 further comprising a step of d) purifying the plant derived proteins, or suprastructure proteins, from the apoplast fraction.

13. The method of claim 12, wherein the step of purifying comprises filtering the apoplast fraction using depth filtration to produced a clarified extract, followed by chromatography of the clarified extract using size exclusion chromatography, cation exchange resin or affinity chromatography, or a combination thereof.

14 A method of preparing plant derived proteins, or suprastructure proteins, comprising:

a. obtaining a plant or plant matter comprising plant-derived proteins or suprastructure proteins,

b. digesting the plant matter using a cell wall degrading enzyme composition to produced a digested fraction;

c. filtering the digested fraction to produced a filtered fraction and recovering the plant-derived proteins, or suprastructure proteins, from the filtered fraction.

15. The method of claim 14 wherein the cell wall degrading enzyme composition comprises one or more than one pectinase, one or more than one cellulase, or one or more than one pectinase and one or more than one cellulase.

16. The method of claim 15 wherein the cell wall degrading enzyme composition comprises one or more than one pectinase, one or more than one cellulase, or one or more than one pectinase and one or more than one cellulase.

17. The method of claim 15 wherein in the step of obtaining (step a), the plant is transformed with a nucleic acid sequence encoding the proteins, or suprastructure proteins, is selected from the group of a peptide, a protein, a protein rosette, a protein complex, a proteasome, a metabolon, a transcription complex, a recombination complex, a photosynthetic complex, a membrane transport complex, a nuclear pore complex, a protein nanoparticle, a glycoprotein, an antibody, a polyclonal antibody, a monoclonal antibody, a single chain monoclonal antibody, a virus like particle, a viral envelope protein, a viral structural protein, a viral capsid protein, and a viral coat protein, a chimeric protein, a chimeric protein complex, a chimeric protein nanoparticle, a chimeric glycoprotein, a chimeric antibody, a chimeric monoclonal antibody, a chimeric single chain monoclonal antibody, a chimeric hemagglutinin, a viral envelope protein, a viral structural protein, a viral capsid protein, and a viral coat protein, and the plant or plant matter is harvested.

18. The method of claim 17, wherein the nucleic acid is introduced into the plant in a transient manner.

19. The method of claim 17, wherein, the nucleic acid is stably integrated within a genome of the plant.

20. The method of claim 17, wherein the plant derived proteins, or suprastructure proteins, comprise a monoclonal antibody or an influenza hemagglutinin.

21. The method of claim 15, wherein the plant matter is selected from the group of leaves, and cultured plant cells.

22. The method of claim 14, further comprising a step d) of separating the proteins or suprastructure proteins, in the filtered fraction from the cellular debris and insoluble materials.

23. The method of claim 22, wherein the step of separating is performed by centrifugation.

24. The method of claim 22 wherein the step of separating is performed by depth filtration.

25. The method of claim 15, further comprising the step of d) purifying the plant derived proteins or suprastructure proteins, from the filtered fraction.

26. The method of claim 25, wherein the step of purifying comprises depth filtration of the filtered fraction to produced a clarified extract, followed by chromatography of the clarified extract using a cation exchange resin, a size exclusion resin, an affinity resin, or a combination thereof.

proteins, or suprastructure proteins, digesting the plant matter using a cell wall degrading enzyme composition to produced a digested fraction, and filtering the digested fraction to produced a filtered fraction and recovering the plant-derived proteins, or suprastructure proteins, from the filtered fraction.

[0025] The enzyme composition may comprise one or more than one pectinase, one or more than one cellulase, or one or more than one pectinase and one or more than one cellulase. Furthermore, if desired, the enzyme composition does not include a lipase or protease, or the composition does not include an added lipase or protease. The plant-derived suprastructure protein may be a chimeric plant-derived suprastructure protein. The plant derived protein suprastructure may include a protein rosette, a protein complex, a proteasome, a metabolon, a transcription complex, a recombination complex, a photosynthetic complex, a membrane transport complex, a nuclear pore complex, a protein nanoparticle, a glycoprotein, an antibody, a polyclonal antibody, a monoclonal antibody, a single chain monoclonal antibody, a virus like particle, a viral envelope protein, a viral structural protein, a viral capsid protein, and a viral coat protein, a chimeric protein, a chimeric protein complex, a chimeric protein nanoparticle, a chimeric glycoprotein, a chimeric antibody, a chimeric monoclonal antibody, a chimeric single chain monoclonal antibody, a chimeric hemagglutinin, a viral envelope protein, a viral structural protein, a viral capsid protein, and a viral coat protein. The plant derived monoclonal antibody may comprise a chimeric mouse human monoclonal antibody, for example but not limited to C2B8. The plant derived VLPs may comprise influenza hemagglutinin.

[0026] The present invention provides a method of preparing plant derived proteins, or suprastructure proteins, as described above (Method B), wherein a nucleic acid encoding the proteins, or suprastructure proteins, is introduced into the plant in a transient manner. Alternatively, the nucleic acid is stably integrated within a genome of the plant.

[0027] The present invention provides a method of preparing plant derived VLPs as described above (Method B) further comprising a step of separating the proteins, or suprastructure proteins, in the filtered fraction from the cellular debris and insoluble materials. The step of separating may be performed by centrifugation, by depth filtration, or bother centrifugation and depth filtration to produce a clarified fraction. The plant derived proteins, or suprastructure proteins, may be further purified by chromatography, for example, the clarified extract may be purified

[0073] Another parameter to set for the plant digestion is the temperature. Temperature may be controlled if desired during the digestion process. Useful temperature range should be between 4°C and 40 °C or any temperature therebetween, for example from about 4°C to about 15°C, or any amount therebetween, or from about 4°C to about 22°C, or any temperature therebetween. Depending to the temperature chosen, the other digestion experimental parameters may be adjusted to maintain optimal extraction conditions.

[0074] Cations, salts or both may be added to improve plasma membrane stability, for example divalent cations, such as Ca^{2+}, or Mg^{2+}, at 0.5-50mM, or any amount therebetween, salts, for example $CaCl_2$, NaCl, $CuSO_4$, KNO_3, and the like, from about 0 to about 750 mM, or any amount therebetween, for example 10, 20, 30, 40, 50, 100, 200, 300, 400, 500, 600, 700 or 750 mM. Other additives may also be added including a chelator for example, but not limited to, EDTA, EGTA, from about 0 to about 200 mM, or any amount therebetween, for example 5, 10, 15, 20, 25, 50, 75, 100, 125, 150, 175, 200 mM, or any amount therebetween, a reducing agent to prevent oxidation such as, but not limited to, sodium bisulfite or ascorbic acid, at 0.005-0.4% or any amount therebetween, for example 0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.07, 0.08, 0.09, 0.1, 0.15, 0.2, 0,25, 0.3, 0.35, 0.4%, or any amount therebetween, specific enzyme inhibitors (see below), and if desired, an inhibitor of foliar senescence, for example, cycloheximide, kinetin, or one or more polyamines.

[0075] The digestion solution may also comprise one or more of mannitol from about 0 to about 600 mM, NaCl from about 0 to about 500 mM, EDTA from about 0 to about 50 mM, cellulase from about 1% to about 2% v/v, pectinase from about 0 to about 1% v/v, sodium metabisulfite from about 0.03 to about 0.04%, citrate from about 0 to about 125 mM or $NaPO_4$ from about 0 to 75 mM.

[0076] The plant matter may be treated to enhance access of the enzymes or enzyme composition to the plant cell wall. For example, the epidermis of the leaf may be removed or 'peeled' before treatment with an enzyme composition. The plant matter may be cut into small pieces (manually, or with a shredding or cutting device such as an Urschel slicer); the cut up plant matter may be further infiltrated with an enzyme composition under a partial vacuum (Nishimura and Beevers 1978, Plant Physiol 62:40-43; Newell et al., 1998, J. Exp Botany 49:817-827). Mechanical perturbation of the plant matter may also be applied to the plant tissues (Giridhar et al., 1989. Protoplasma 151:151-157) before or during treatment with an enzyme composition.

theory, since Ca^{2+} plays a critical role in the retention of constituents of the cell wall's middle lamellae together, and given the fact that there is usually a high concentration of Ca^{2+} in plant cell wall, the addition of Ca^{2+}-chelator EDTA could facilitate the enzymatic depolymerisation of the cell wall, thereby preserving intact intracellular organelles, such as chloroplasts, and preventing the release green-pigments components.

[00155] As shown in Table 6, the addition of 25mM EDTA to the digestion buffer allowed for the reduction of the green coloration of the purified H5-VLP preparation, as evaluated by measuring the difference in absorption of the preparation (OD_{672nm} - OD_{650nm}). When the green constituents were released in high quantity, or not suitably removed, VLP preparation exhibited a $\Delta OD > 0.040$.

Table 6 : Effect of the addition of 25 mM EDTA to the digestion buffer on green coloration of H5-VLP preparations.

	OD_{672nm} - OD_{650nm}
0 mM NaCl, 0 mM EDTA	**0.071 ± 0.061**
500 mM NaCl	**0.087 ± 0.060**
500 mM NaCl + 25 mM EDTA	**0.010 ± 0.002**

Example 7: Alternative digestion buffer compositions

[00156] *N. benthamiana* plants were agroinfiltrated with *Agrobacterium* AGL1 strains carrying a construct expressing a hemagglutinin of interest (H5/Indo) as described in Example 1. Leaves were collected on day 6 post-infiltration, cut into ~1 cm^2 pieces and digested according to Example 4, with modification of digestion buffer to include 0%, 0.25%, 0.5%, 0.75% or 1% v/v Multifect Pectinase FE, Multifect CX- CG cellulase and Multifect CX B cellulase as noted in Tables 7-9. Filtration, centrifugation and clarification were as described in Example 4.

[00157] As shown in following tables 7 and 8, pectinase has been demonstrated to be non-essential in the digestion buffer. Similar levels of H5/Indo or H1/Cal WT VLP can be extracted with the present method either in the presence or absence of pectinase. Furthermore, it has been

WHAT IS CLAIMED IS:

1. A method of preparing plant derived proteins, or protein suprastructures, comprising:

a. obtaining a plant or plant matter comprising apoplast-localized proteins, or suprastructure proteins,

b. producing a protoplast/spheroplast fraction and an apoplast fraction by treating the plant or plant matter with a cell wall degrading multi-component enzyme mixture comprising one or more than one cellulase; and,

c. recovering the apoplast fraction, the apoplast fraction comprising the plant-derived proteins, or suprastructure proteins, wherein the protein suprastructures have a molecular weight from about 75 to about 1500 kDa.

2. The method of claim 1 wherein the cell wall degrading multi-component enzyme mixture further comprises one or more than one pectinase.

3. The method of claim 2, wherein the concentration of the one or more than one pectinase is between 0.01% v/v to 2.5% v/v.

4. The method of claim 1, wherein the concentration of the one or more than one cellulase is between 0.1% to 5% w/v.

5. The method of claim 1 , wherein the cell wall degrading multi-component enzyme mixture does not include one or more of a lipase, a protease or a pectinase.

6. The method of claim 1 wherein in the step of obtaining (step a), the plant is transformed with a nucleic acid sequence encoding the proteins, or suprastructure proteins, is selected from the group of a peptide, a protein, a protein rosette, a protein complex, a proteasome, a metabolon, a transcription complex, a recombination complex, a photosynthetic complex, a membrane transport complex, a nuclear pore complex, a protein nanoparticle, a glycoprotein, an antibody, a polyclonal antibody, a monoclonal antibody, a single chain monoclonal antibody, a viral envelope protein, a viral structural protein, a viral capsid protein, and a viral coat protein, a chimeric protein, a chimeric protein complex, a chimeric protein nanoparticle, a chimeric glycoprotein, a chimeric antibody, a chimeric monoclonal antibody, a chimeric single chain monoclonal antibody, a chimeric hemagglutinin, a viral envelope protein, a viral structural protein, a viral capsid protein, and a viral coat protein, and the plant or plant matter is harvested.

7. The method of claim 6, wherein the nucleic acid is introduced into the plant in a transient manner.

8. The method of claim 6, wherein, the nucleic acid is stably integrated within a genome of the plant.

9. The method of claim 1 wherein in the step of obtaining (step a), the plant is grown and the plant or plant matter harvested.

10. The method of claim 6 wherein the nucleic acid encodes a monoclonal antibody or an influenza hemagglutinin.

11. The method of claim 1 wherein the plant derived proteins, or suprastructure proteins, do not include neuraminidase or M protein.

12. The method of claim 1 wherein the plant matter is selected from the group of leaves, and cultured plant cells.

13. The method of claim 1 further comprising a step of d) purifying the plant derived proteins, or suprastructure proteins, from the apoplast fraction.

14. The method of claim 13, wherein the step of purifying comprises filtering the apoplast fraction using depth filtration to produce a clarified extract, followed by chromatography of the clarified extract using size exclusion chromatography, cation exchange resin or affinity chromatography, or a combination thereof.

15. A method of preparing plant derived proteins, or protein suprastructures, comprising:

a. obtaining a plant or plant matter comprising plant-derived proteins or suprastructure proteins,

b. digesting the plant matter using a cell wall degrading multi-component enzyme mixture comprising one or more than one cellulase to produced a digested fraction;

c. filtering the digested fraction to produced a filtered fraction and recovering the plant-derived proteins, or suprastructure proteins, from the filtered fraction, wherein the protein suprastructures have a molecular weight from about 75 to about 1500 kDa.

16. The method of claim 15 wherein the cell wall degrading multi-component enzyme mixture further comprises one or more than one pectinase.

17. The method of claim 16, wherein the concentration of the one or more than one pectinase is between 0.01% v/v to 2.5% v/v.

18. The method of claim 15, wherein the concentration of the one or more than one cellulase is between 0.1% to 5% w/v.

19. The method of claim 15, wherein the cell wall degrading multi-component enzyme mixture does not include one or more of a lipase, a protease or a pectinase.

20. The method of claim 15 wherein in the step of obtaining (step a), the plant is transformed with a nucleic acid sequence encoding the proteins, or suprastructure proteins, is selected from the group of a peptide, a protein, a protein rosette, a protein complex, a proteasome, a metabolon, a transcription complex, a recombination complex, a photosynthetic complex, a membrane transport complex, a nuclear pore complex, a protein nanoparticle, a glycoprotein, an antibody, a polyclonal antibody, a monoclonal antibody, a single chain monoclonal antibody,
a viral envelope protein, a viral structural protein, a viral capsid protein, and a viral coat

protein, a chimeric protein, a chimeric protein complex, a chimeric protein nanoparticle, a chimeric glycoprotein, a chimeric antibody, a chimeric monoclonal antibody, a chimeric single chain monoclonal antibody, a chimeric hemagglutinin, a viral envelope protein, a viral structural protein, a viral capsid protein, and a viral coat protein, and the plant or plant matter is harvested.

21. The method of claim 20, wherein the nucleic acid is introduced into the plant in a transient manner.

22. The method of claim 20, wherein, the nucleic acid is stably integrated within a genome of the plant.

23. The method of claim 20, wherein the plant derived proteins, or suprastructure proteins, comprise a monoclonal antibody or an influenza hemagglutinin.

24. The method of claim 15, wherein the plant matter is selected from the group of leaves, and cultured plant cells.

25. The method of claim 15, further comprising a step d) of separating the proteins or protein suprastructures, in the filtered fraction from the cellular debris and insoluble materials.

26. The method of claim 25, wherein the step of separating is performed by centrifugation.

27. The method of claim 25 wherein the step of separating is performed by depth filtration.

28. The method of claim 15, further comprising the step of d) purifying the plant derived proteins or protein suprastructures, from the filtered fraction.

29. The method of claim 28, wherein the step of purifying comprises depth filtration of the filtered fraction to produced a clarified extract, followed by chromatography of the clarified extract using a cation exchange resin, a size exclusion resin, an affinity resin, or a combination thererof.