

be, as described, a component of a viral inactivation operation, and the protein in the solution can be of any type, for example a protein such as an antigen binding protein (*e.g.*, one or more of (i) an antigen binding protein comprising one or more of a monoclonal antibody, a human antibody, a humanized antibody, a chimeric antibody, a recombinant antibody, a single chain antibody, a diabody, a triabody, a tetrabody, a Fab fragment, a F(ab')₂ fragment, an IgD antibody, an IgE antibody, an IgM antibody, an IgG1 antibody, an IgG2 antibody, an IgG3 antibody, or an IgG4 antibody, and fragments thereof, (ii) an Fc domain; (iii) a peptide; (iv) an Fc fusion protein; and (v) a therapeutic protein).

SUMMARY OF THE INVENTION

In one aspect, the present invention refers to a method of inactivating a virus in a sample comprising an antibody comprising: (a) providing a sample comprising the antibody, wherein the sample is known or suspected to contain a virus; (b) adding a protectant to the sample to form a stabilized mixture, wherein the protectant comprises one or more of tyrosine, tryptophan, and methionine; and (c) exposing the stabilized mixture to a target dose of UV-C light under which the virus is inactivated, wherein the UV-C light is provided by a source operating at a selected power level and selected wavelength for a selected period of time; (d) assessing the UV-C exposure level of the stabilized mixture; and (e) modulating one or more of the wavelength, the UV light source power and the UV light exposure time if the assessment indicates the target dose of UV-C light has not been delivered to the stabilized mixture. In another aspect, the present invention refers to a method of reducing protein degradation or modification arising from the presence of a reactive species generated during UV exposure comprising: (a) providing a sample comprising an antibody; (b) adding a protectant to the sample to form a stabilized mixture, wherein the protectant comprises one or more of tyrosine, tryptophan, and methionine; and (c) exposing the stabilized mixture to a target dose of UV-C light, wherein the UV-C light is provided by a source operating at a selected power level and selected wavelength for a selected period of time; (d) assessing the UV-C exposure level of the stabilized mixture; and (e) modulating one or more of the wavelength, the UV light source power and the UV light exposure time if the assessment indicates the target dose of UV-C light has not been delivered to the stabilized mixture. In still another aspect, the present invention refers to a method for inactivating a virus in a therapeutic antibody preparation comprising: (a) providing a sample comprising the therapeutic antibody, wherein the sample is an effluent stream from an antibody purification step and the sample is known or suspected to contain a virus; (b) introducing a protectant into the effluent stream to form a stabilized mixture, wherein the protectant comprises tyrosine, tryptophan, methionine, or combinations thereof; (c) measuring the absorbance of the stabilized mixture at 254 nm by in-line absorption spectroscopy; (ed) passing the stabilized mixture through a device configured to provide continuous exposure to UV-C light such that a target dose of UV-C light under which the virus is inactivated is delivered to the mixture; and (e) adjusting the flow rate of the stabilized mixture through the device based on the absorbance measurement such that the target dose of UV-C light is continually delivered to the stabilized mixture passing through the device; ~~(d) removing the protectant from the mixture following UV-C light exposure.~~

In one example a method of inactivating a virus in a sample comprising a protein component is provided. In one example the method comprises (a) providing a sample comprising a protein component, wherein the sample is known or suspected to contain a virus; (b) identifying a target dose of UV light under which the virus is inactivated; (c) adding a protectant to the

CLAIMS

What is claimed is:

1. A method of inactivating a virus in a sample comprising an antibody comprising:
 - (a) providing a sample comprising the antibody, wherein the sample is known or suspected to contain a virus;
 - (b) adding a protectant to the sample to form a stabilized mixture, wherein the protectant comprises one or more of tyrosine, tryptophan, and methionine; and
 - (c) exposing the stabilized mixture to a target dose of UV-C light under which the virus is inactivated, wherein the UV-C light is provided by a source operating at a selected power level and selected wavelength for a selected period of time.
2. The method of claim 1, further comprising:
 - (d) assessing the UV-C exposure level of the stabilized mixture; and
 - (e) modulating one or more of the wavelength, the UV light source power and the UV light exposure time if the assessment indicates the target dose of UV-C light has not been delivered to the stabilized mixture.
3. The method of claim 1 or 2, further comprising removing the protectant from the mixture following exposure to UV-C light.
4. The method of claim 1, wherein the sample comprises a chromatography column pool.
5. The method of claim 4, wherein the pool comprises one or more of a Protein A column eluant pool comprising the antibody, a Protein G column eluant pool comprising the antibody, a HIC column pool comprising the antibody, a SEC column pool comprising the antibody, an IEC column pool comprising the antibody, and a hydroxyapatite column pool comprising the antibody.
6. The method of claim 1, wherein the sample comprises a chromatography column effluent stream.

7. The method of claim 6, wherein the effluent stream comprises one or more of a Protein A column effluent stream comprising the antibody, a Protein G column effluent stream comprising the antibody, a HIC column effluent stream comprising the antibody, a SEC column effluent stream comprising the antibody, an IEC column effluent stream comprising the antibody, and a hydroxyapatite column effluent stream comprising the antibody.

8. The method of claim 1, wherein the antibody is a monoclonal antibody, a human antibody, a humanized antibody, a chimeric antibody, a recombinant antibody, a single chain antibody, an IgD antibody, an IgE antibody, an IgM antibody, an IgG1 antibody, an IgG2 antibody, an IgG3 antibody, or an IgG4 antibody.

9. The method of claim 1, wherein the virus comprises one or more of a dsDNA virus, a ssDNA virus, a dsRNA virus and a ssRNA virus.

10. The method of claim 9, wherein the virus comprises a virus of one or more of the virus families *adenoviridae*, *asfarviridae*, *herpesviridae*, *iridoviridae*, *papillomaviridae*, *polyomaviridae*, *poxviridae*, *circoviridae*, *hepadnaviridae*, *parvoviridae*, *birnaviridae*, *reoviridae*, *arenaviridae*, *bornaviridae*, *bunyaviridae*, *deltaviridae*, *filoviridae*, *orthomyxoviridae*, *paramyxoviridae*, *rhabdoviridae*, *arterioviridae*, *astroviridae*, *caliciviridae*, *coronaviridae*, *flaviviridae*, HEV-like viruses, *nodaviridae*, *picornaviridae*, *togaviridae*, and *retroviridae*.

11. The method of claim 10, wherein the virus is the parvovirus MVM, the retrovirus MuLV or the bunya virus CVV.

12. The method of claim 1, wherein the protectant is added to the sample in a concentration ratio of greater than 1 part protectant to 200 parts antibody.

13. The method of claim 1, wherein the protectant comprises (i) tyrosine; (ii) tryptophan; or (iii) tyrosine and tryptophan.

14. The method of claim 1, wherein the UV-C light has a wavelength in the range of 200 nm to 280 nm.
15. The method of claim 14, wherein the UV-C light has a wavelength of 254 nm.
16. The method of claim 1, wherein the target dose is 1 mJ/cm², 10 mJ/cm², 25 mJ/cm², 50 mJ/cm², 75 mJ/cm², 100 mJ/cm², 125 mJ/cm², 200 mJ/cm², 250 mJ/cm², 300 mJ/cm², 350 mJ/cm², 400 mJ/cm², 450 mJ/cm², 500 mJ/cm², 600 mJ/cm², 700 mJ/cm², 800 mJ/cm², 900 mJ/cm², 1000 mJ/cm² or greater than 1000 mJ/cm².
17. The method of claim 1, wherein the method provides a viral log reduction value (LRV) of greater than or equal to 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5 or greater than 6.5.
18. The method of claim 1, wherein the method is automated.
19. The method of claim 1, wherein the method is performed as a step in an antibody purification operation.
20. A method of reducing protein degradation or modification arising from the presence of a reactive species generated during UV exposure comprising:
 - (a) providing a sample comprising an antibody;
 - (b) adding a protectant to the sample to form a stabilized mixture, wherein the protectant comprises one or more of tyrosine, tryptophan, and methionine; and
 - (c) exposing the stabilized mixture to a target dose of UV-C light, wherein the UV-C light is provided by a source operating at a selected power level and selected wavelength for a selected period of time.
21. The method of claim 20, further comprising:
 - (d) assessing the UV-C exposure level of the stabilized mixture; and
 - (e) modulating one or more of the wavelength, the UV light source power and the UV light exposure time if the assessment indicates the target dose of UV-C light has not been delivered to the stabilized mixture.

22. The method of claim 20 or 21, further comprising removing the protectant from the mixture following exposure to UV-C light.

23. The method of claim 20, wherein the sample comprises a chromatography column pool.

24. The method of claim 23, wherein the pool comprises one or more of a Protein A column eluant pool comprising the antibody, a Protein G column eluant pool comprising the antibody, a HIC column pool comprising the antibody, a SEC column pool comprising the antibody, an IEC column pool comprising the antibody, and a hydroxyapatite column pool comprising the antibody.

25. The method of claim 20, wherein the sample comprises a chromatography column effluent stream.

26. The method of claim 25, wherein the effluent stream comprises one or more of a Protein A column effluent stream comprising the antibody, a Protein G column effluent stream comprising the antibody, a HIC column effluent stream comprising the antibody, a SEC column effluent stream comprising the antibody, an IEC column effluent stream comprising the antibody, and a hydroxyapatite column effluent stream comprising the antibody.

27. The method of claim 20, wherein the antibody is a monoclonal antibody, a human antibody, a humanized antibody, a chimeric antibody, a recombinant antibody, a single chain antibody, an IgD antibody, an IgE antibody, an IgM antibody, an IgG1 antibody, an IgG2 antibody, an IgG3 antibody, or an IgG4 antibody.

28. The method of claim 20, wherein the protectant is added to the sample in a concentration ratio of greater than 1 part protectant to 200 parts antibody.

29. The method of claim 20, wherein the protectant comprises (i) tyrosine; (ii) tryptophan; or (iii) tyrosine and tryptophan.

30. The method of claim 20, wherein the UV-C light has a wavelength in the range of 200 nm to 280 nm.

31. The method of claim 30, wherein the UV-C light has a wavelength of 254 nm.

32. The method of claim 20, wherein the target dose is 1 mJ/cm², 10 mJ/cm², 25 mJ/cm², 50 mJ/cm², 75 mJ/cm², 100 mJ/cm², 125 mJ/cm², 200 mJ/cm², 250 mJ/cm², 300 mJ/cm², 350 mJ/cm², 400 mJ/cm², 450 mJ/cm², 500 mJ/cm², 600 mJ/cm², 700 mJ/cm², 800 mJ/cm², 900 mJ/cm², 1000 mJ/cm² or greater than 1000 mJ/cm².

33. The method of claim 20, wherein the method is automated.

34. The method of claim 20, wherein the method is performed as a step in an antibody purification operation.

35. A method for inactivating a virus in a therapeutic antibody preparation comprising:

(a) providing a sample comprising the therapeutic antibody, wherein the sample is an effluent stream from an antibody purification step and the sample is known or suspected to contain a virus;

(b) introducing a protectant into the effluent stream to form a stabilized mixture, wherein the protectant comprises tyrosine, tryptophan, methionine, or combinations thereof,

(c) passing the stabilized mixture through a device configured to provide continuous exposure to UV-C light such that a target dose of UV-C light under which the virus is inactivated is delivered to the mixture; and

(d) removing the protectant from the mixture following UV-C light exposure.

36. The method of claim 35, further comprising measuring the absorbance of the stabilized mixture at 254 nm by in-line absorption spectroscopy prior to UV-C light exposure; and adjusting the flow rate of the stabilized mixture through the device based on the absorbance measurement such that the target dose of UV-C light is continually delivered to the stabilized mixture passing through the device.

37. The method of claim 35, wherein the sample is an effluent stream from a Protein A column.

38. The method of claim 35, wherein the sample is an effluent stream from a depth filtration step.

39. The method of claim 35, wherein the therapeutic antibody is a monoclonal antibody, a human antibody, a humanized antibody, a chimeric antibody, a recombinant antibody, a single chain antibody, an IgD antibody, an IgE antibody, an IgM antibody, an IgG1 antibody, an IgG2 antibody, an IgG3 antibody, or an IgG4 antibody.

40. The method of claim 35, wherein the target dose is 1 mJ/cm², 10 mJ/cm², 25 mJ/cm², 50 mJ/cm², 75 mJ/cm², 100 mJ/cm², 125 mJ/cm², 200 mJ/cm², 250 mJ/cm², 300 mJ/cm², 350 mJ/cm², 400 mJ/cm², 450 mJ/cm², 500 mJ/cm², 600 mJ/cm², 700 mJ/cm², 800 mJ/cm², 900 mJ/cm², 1000 mJ/cm² or greater than 1000 mJ/cm².

41. The method of claim 35, wherein the method provides a viral LRV of greater than or equal to 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5 or greater than 6.5.

42. The method of claim 35, wherein the UV-C light has a wavelength in the range of 200 nm to 280 nm.

43. The method of claim 42, wherein the UV-C light has a wavelength of 254 nm.

44. The method of claim 35, wherein the virus comprises one or more of a dsDNA virus, a ssDNA virus, a dsRNA virus and a ssRNA virus.

45. The method of claim 44, wherein the virus comprises a virus of one or more of the virus families *adenoviridae*, *asfarviridae*, *herpesviridae*, *iridoviridae*, *papillomaviridae*, *polyomaviridae*, *poxviridae*, *circoviridae*, *hepadnaviridae*, *parvoviridae*, *birnaviridae*, *reoviridae*, *arenaviridae*, *vornaviridae*, *bunyaviridae*, *deltaviridae*, *filoviridae*, *orthomyxoviridae*, *paramyxoviridae*, *rhabdoviridae*, *arterioviridae*, *astroviridae*, *caliciviridae*, *coronaviridae*, *flaviviridae*, HEV-like viruses, *nodaviridae*, *picornaviridae*, *togaviridae*, and *retroviridae*.

46. The method of claim 45, wherein the virus is the parvovirus MVM, the retrovirus MuLV or the bunya virus CVV.

CLAIMS

What is claimed is:

1. A method of inactivating a virus in a sample comprising an antibody comprising:
 - (a) providing a sample comprising the antibody, wherein the sample is known or suspected to contain a virus;
 - (b) adding a protectant to the sample to form a stabilized mixture, wherein the protectant comprises one or more of tyrosine, tryptophan, and methionine;
 - (c) exposing the stabilized mixture to a target dose of UV-C light under which the virus is inactivated, wherein the UV-C light is provided by a source operating at a selected power level and selected wavelength for a selected period of time;
 - (d) assessing the UV-C exposure level of the stabilized mixture; and
 - (e) modulating one or more of the wavelength, the UV light source power and the UV light exposure time if the assessment indicates the target dose of UV-C light has not been delivered to the stabilized mixture.
2. The method of claim 1, wherein steps (d) and (e) are conducted as part of a feedback loop.
3. The method of claim 1 or 2, further comprising removing the protectant from the mixture following exposure to UV-C light.
4. The method of claim 1, wherein the sample comprises a chromatography column pool.
5. The method of claim 4, wherein the pool comprises one or more of a Protein A column eluant pool comprising the antibody, a Protein G column eluant pool comprising the antibody, a HIC column pool comprising the antibody, a SEC column pool comprising the antibody, an IEC column pool comprising the antibody, and a hydroxyapatite column pool comprising the antibody.

6. The method of claim 1, wherein the sample comprises a chromatography column effluent stream.

7. The method of claim 6, wherein the effluent stream comprises one or more of a Protein A column effluent stream comprising the antibody, a Protein G column effluent stream comprising the antibody, a HIC column effluent stream comprising the antibody, a SEC column effluent stream comprising the antibody, an IEC column effluent stream comprising the antibody, and a hydroxyapatite column effluent stream comprising the antibody.

8. The method of claim 1, wherein the antibody is a monoclonal antibody, a human antibody, a humanized antibody, a chimeric antibody, a recombinant antibody, a single chain antibody, an IgD antibody, an IgE antibody, an IgM antibody, an IgG1 antibody, an IgG2 antibody, an IgG3 antibody, or an IgG4 antibody.

9. The method of claim 1, wherein the virus comprises one or more of a dsDNA virus, a ssDNA virus, a dsRNA virus and a ssRNA virus.

10. The method of claim 9, wherein the virus comprises a virus of one or more of the virus families *adenoviridae*, *asfarviridae*, *herpesviridae*, *iridoviridae*, *papillomaviridae*, *polyomaviridae*, *poxviridae*, *circoviridae*, *hepadnaviridae*, *parvoviridae*, *birnaviridae*, *reoviridae*, *arenaviridae*, *vornaviridae*, *bunyaviridae*, *deltaviridae*, *filoviridae*, *orthomyxoviridae*, *paramyxoviridae*, *rhabdoviridae*, *arterioviridae*, *astroviridae*, *caliciviridae*, *coronaviridae*, *flaviviridae*, HEV-like viruses, *nodaviridae*, *picornaviridae*, *togaviridae*, and *retroviridae*.

11. The method of claim 10, wherein the virus is the parvovirus MVM, the retrovirus MuLV or the bunya virus CVV.

12. The method of claim 1, wherein the protectant is added to the sample in a concentration ratio of greater than 1 part protectant to 200 parts antibody.

13. The method of claim 1, wherein the protectant comprises (i) tyrosine; (ii) tryptophan; or (iii) tyrosine and tryptophan.

14. The method of claim 1, wherein the UV-C light has a wavelength in the range of 200 nm to 280 nm.

15. The method of claim 14, wherein the UV-C light has a wavelength of 254 nm.

16. The method of claim 1, wherein the target dose is 1 mJ/cm², 10 mJ/cm², 25 mJ/cm², 50 mJ/cm², 75 mJ/cm², 100 mJ/cm², 125 mJ/cm², 200 mJ/cm², 250 mJ/cm², 300 mJ/cm², 350 mJ/cm², 400 mJ/cm², 450 mJ/cm², 500 mJ/cm², 600 mJ/cm², 700 mJ/cm², 800 mJ/cm², 900 mJ/cm², 1000 mJ/cm² or greater than 1000 mJ/cm².

17. The method of claim 1, wherein the method provides a viral log reduction value (LRV) of greater than or equal to 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5 or greater than 6.5.

18. The method of claim 1, wherein the method is automated.

19. The method of claim 1, wherein the method is performed as a step in an antibody purification operation.

20. A method of reducing protein degradation or modification arising from the presence of a reactive species generated during UV exposure comprising:

- (a) providing a sample comprising an antibody;
- (b) adding a protectant to the sample to form a stabilized mixture, wherein the protectant comprises one or more of tyrosine, tryptophan, and methionine;
- (c) exposing the stabilized mixture to a target dose of UV-C light, wherein the UV-C light is provided by a source operating at a selected power level and selected wavelength for a selected period of time;
- (d) assessing the UV-C exposure level of the stabilized mixture; and
- (e) modulating one or more of the wavelength, the UV light source power and the UV light exposure time if the assessment indicates the target dose of UV-C light has not been delivered to the stabilized mixture.

21. The method of claim 20, wherein steps (d) and (e) are conducted as part of a feedback loop.

22. The method of claim 20 or 21, further comprising removing the protectant from the mixture following exposure to UV-C light.

23. The method of claim 20, wherein the sample comprises a chromatography column pool.

24. The method of claim 23, wherein the pool comprises one or more of a Protein A column eluant pool comprising the antibody, a Protein G column eluant pool comprising the antibody, a HIC column pool comprising the antibody, a SEC column pool comprising the antibody, an IEC column pool comprising the antibody, and a hydroxyapatite column pool comprising the antibody.

25. The method of claim 20, wherein the sample comprises a chromatography column effluent stream.

26. The method of claim 25, wherein the effluent stream comprises one or more of a Protein A column effluent stream comprising the antibody, a Protein G column effluent stream comprising the antibody, a HIC column effluent stream comprising the antibody, a SEC column effluent stream comprising the antibody, an IEC column effluent stream comprising the antibody, and a hydroxyapatite column effluent stream comprising the antibody.

27. The method of claim 20, wherein the antibody is a monoclonal antibody, a human antibody, a humanized antibody, a chimeric antibody, a recombinant antibody, a single chain antibody, an IgD antibody, an IgE antibody, an IgM antibody, an IgG1 antibody, an IgG2 antibody, an IgG3 antibody, or an IgG4 antibody.

28. The method of claim 20, wherein the protectant is added to the sample in a concentration ratio of greater than 1 part protectant to 200 parts antibody.

29. The method of claim 20, wherein the protectant comprises (i) tyrosine; (ii) tryptophan; or (iii) tyrosine and tryptophan.

30. The method of claim 20, wherein the UV-C light has a wavelength in the range of 200 nm to 280 nm.

31. The method of claim 30, wherein the UV-C light has a wavelength of 254 nm.

32. The method of claim 20, wherein the target dose is 1 mJ/cm², 10 mJ/cm², 25 mJ/cm², 50 mJ/cm², 75 mJ/cm², 100 mJ/cm², 125 mJ/cm², 200 mJ/cm², 250 mJ/cm², 300 mJ/cm², 350 mJ/cm², 400 mJ/cm², 450 mJ/cm², 500 mJ/cm², 600 mJ/cm², 700 mJ/cm², 800 mJ/cm², 900 mJ/cm², 1000 mJ/cm² or greater than 1000 mJ/cm².

33. The method of claim 20, wherein the method is automated.

34. The method of claim 20, wherein the method is performed as a step in an antibody purification operation.

35. A method for inactivating a virus in a therapeutic antibody preparation comprising:

(a) providing a sample comprising the therapeutic antibody, wherein the sample is an effluent stream from an antibody purification step and the sample is known or suspected to contain a virus;

(b) introducing a protectant into the effluent stream to form a stabilized mixture, wherein the protectant comprises tyrosine, tryptophan, methionine, or combinations thereof;

(c) measuring the absorbance of the stabilized mixture at 254 nm by in-line absorption spectroscopy;

(d) passing the stabilized mixture through a device configured to provide continuous exposure to UV-C light such that a target dose of UV-C light under which the virus is inactivated is delivered to the mixture; and

(e) adjusting the flow rate of the stabilized mixture through the device based on the absorbance measurement such that the target dose of UV-C light is continually delivered to the stabilized mixture passing through the device.

36. The method of claim 35, wherein steps (c), (d) and (e) are conducted as part of a feedback loop.

37. The method of claim 35, wherein the sample is an effluent stream from a Protein A column.

38. The method of claim 35, wherein the sample is an effluent stream from a depth filtration step.

39. The method of claim 35, wherein the therapeutic antibody is a monoclonal antibody, a human antibody, a humanized antibody, a chimeric antibody, a recombinant antibody, a single chain antibody, an IgD antibody, an IgE antibody, an IgM antibody, an IgG1 antibody, an IgG2 antibody, an IgG3 antibody, or an IgG4 antibody.

40. The method of claim 35, wherein the target dose is 1 mJ/cm², 10 mJ/cm², 25 mJ/cm², 50 mJ/cm², 75 mJ/cm², 100 mJ/cm², 125 mJ/cm², 200 mJ/cm², 250 mJ/cm², 300 mJ/cm², 350 mJ/cm², 400 mJ/cm², 450 mJ/cm², 500 mJ/cm², 600 mJ/cm², 700 mJ/cm², 800 mJ/cm², 900 mJ/cm², 1000 mJ/cm² or greater than 1000 mJ/cm².

41. The method of claim 35, wherein the method provides a viral LRV of greater than or equal to 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5 or greater than 6.5.

42. The method of claim 35, wherein the UV-C light has a wavelength in the range of 200 nm to 280 nm.

43. The method of claim 42, wherein the UV-C light has a wavelength of 254 nm.

44. The method of claim 35, wherein the virus comprises one or more of a dsDNA virus, a ssDNA virus, a dsRNA virus and a ssRNA virus.

45. The method of claim 44, wherein the virus comprises a virus of one or more of the virus families *adenoviridae*, *asfarviridae*, *herpesviridae*, *iridoviridae*, *papillomaviridae*, *polyomaviridae*, *poxviridae*, *circoviridae*, *hepadnaviridae*, *parvoviridae*, *birnaviridae*, *reoviridae*, *arenaviridae*, *vornaviridae*, *bunyaviridae*, *deltaviridae*, *filoviridae*,

orthomyxoviridae, *paramyxoviridae*, *rhabdoviridae*, *arterioviridae*, *astroviridae*, *caliciviridae*, *coronaviridae*, *flaviviridae*, HEV-like viruses, *nodaviridae*, *picornaviridae*, *togaviridae*, and *retroviridae*.

46. The method of claim 45, wherein the virus is the parvovirus MVM, the retrovirus MuLV or the bunya virus CVV.