

What is claimed is:

Claims

1. A pathogen control composition comprising a plurality of PMPs, wherein each of the plurality of PMPs comprises a heterologous pathogen control agent and wherein the composition is formulated for delivery to an agricultural or veterinary animal pathogen or a vector thereof.
2. The pathogen control composition of claim 1, wherein the heterologous pathogen control agent is an antibacterial agent, an antifungal agent, a virucidal agent, an anti-viral agent, an insecticidal agent, a nematicidal agent, an antiparasitic agent, or an insect repellent.
3. The pathogen control composition of claim 2, wherein the antibacterial agent is doxorubicin.
4. The pathogen control composition of claim 2, wherein the antibacterial agent is an antibiotic.
5. The pathogen control composition of claim 4, wherein the antibiotic is vancomycin.
6. The pathogen control composition of claim 4, wherein the antibiotic is a penicillin, a cephalosporin, a monobactam, a carbapenem, a macrolide, an aminoglycoside, a quinolone, a sulfonamide, a tetracycline, a glycopeptide, a lipoglycopeptide, an oxazolidinone, a rifamycin, a tuberactinomycin, chloramphenicol, metronidazole, tinidazole, nitrofurantoin, teicoplanin, telavancin, linezolid, cycloserine 2, bacitracin, polymyxin B, viomycin, or capreomycin.
7. The pathogen control composition of claim 2, wherein the antifungal agent is an allylamine, an imidazole, a triazole, a thiazole, a polyene, or an echinocandin.
8. The pathogen control composition of claim 2, wherein the insecticidal agent is a chloronicotinyl, a neonicotinoid, a carbamate, an organophosphate, a pyrethroid, an oxadiazine, a spinosyn, a cyclodiene, an organochlorine, a fiprole, a mectin, a diacylhydrazine, a benzoylurea, an organotin, a pyrrole, a dinitroterpenol, a METI, a tetronic acid, a tetramic acid, or a pthalamide.
9. The pathogen control composition of claim 1, wherein the heterologous pathogen control agent is a small molecule, a nucleic acid, or a polypeptide.
10. The pathogen control composition of claim 9, wherein the small molecule is an antibiotic or a secondary metabolite.
11. The pathogen control composition of claim 9, wherein the nucleic acid is an inhibitory RNA.
12. The pathogen control composition of claim 1, wherein the heterologous pathogen control agent is encapsulated by each of the plurality of PMPs.

13. The pathogen control composition of claim 1, wherein the heterologous pathogen control agent is embedded on the surface of each of the plurality of PMPs.
14. The pathogen control composition of claim 1, wherein the heterologous pathogen control agent is conjugated to the surface of each of the plurality of PMPs.
15. The pathogen control composition of claim 1, wherein each of the plurality of PMPs further comprises an additional pathogen control agent.
16. The pathogen control composition of claim 1, wherein the pathogen is a bacterium, a fungus, a parasitic insect, a parasitic nematode, or a parasitic protozoan.
17. The pathogen control composition of claim 16, wherein the bacterium is a *Pseudomonas* species, an *Escherichia* species, a *Streptococcus* species, a *Pneumococcus* species, a *Shigella* species, a *Salmonella* species, or a *Campylobacter* species.
18. The pathogen control composition of claim 17, wherein the *Pseudomonas* species is *Pseudomonas aeruginosa*.
19. The pathogen control composition of claim 17, wherein the *Escherichia* species is *Escherichia coli*.
20. The pathogen control composition of claim 16, wherein the fungus is a *Saccharomyces* species or a *Candida* species.
21. The pathogen control composition of claim 16, wherein the parasitic insect is a *Cimex* species.
22. The pathogen control composition of claim 16, wherein the parasitic nematode is a *Heligmosomoides* species.
23. The pathogen control composition of claim 16, wherein the parasitic protozoan is a *Trichomonas* species.
24. The pathogen control composition of claim 1, wherein the vector is an insect.
25. The pathogen control composition of claim 24, wherein the vector is a mosquito, a tick, a mite, or a louse.
26. The pathogen control composition of claim 1, wherein the composition is stable for at least one day at room temperature, and/or stable for at least one week at 4°C.
27. The pathogen control composition of claim 1, wherein the PMPs are stable for at least 24 hours, 48 hours, seven days, or 30 days at 4°C.

28. The pathogen control composition of claim 27, wherein the PMPs are stable at a temperature of at least 20°C, 24°C, or 37°C.
29. The pathogen control composition of claim 1, wherein the plurality of PMPs in the composition is at a concentration effective to decrease the fitness of an animal pathogen.
30. The pathogen control composition of claim 1, wherein the plurality of PMPs in the composition is at a concentration effective to decrease the fitness of an animal pathogen vector.
31. The pathogen control composition of claim 1, wherein the plurality of PMPs in the composition is at a concentration effective to treat an infection in an animal infected with a pathogen.
32. The pathogen control composition of claim 1, wherein the plurality of PMPs in the composition is at a concentration effective to prevent an infection in an animal at risk of an infection with a pathogen.
33. The pathogen control composition of claim 1, wherein the plurality of PMPs in the composition is at a concentration of 0.01 ng, 0.1 ng, 1 ng, 2 ng, 3 ng, 4 ng, 5 ng, 10 ng, 50 ng, 100 ng, 250 ng, 500 ng, 750 ng, 1 µg, 10 µg, 50 µg, 100 µg, or 250 µg PMP protein/ml.
34. The pathogen control composition of claim 1, wherein the composition comprises an agriculturally acceptable carrier.
35. The pathogen control composition of claim 1, wherein the composition comprises a pharmaceutically acceptable carrier.
36. The pathogen control composition of claim 1, wherein the composition is formulated to stabilize the PMPs.
37. The pathogen control composition of claim 1, wherein the composition is formulated as a liquid, a solid, an aerosol, a paste, a gel, or a gas composition.
38. The pathogen control composition of claim 1, wherein the composition comprises at least 5% PMPs.
39. A pathogen control composition comprising a plurality of PMPs, wherein the PMPs are isolated from a plant by a process which comprises the steps of:
- (a) providing an initial sample from a plant, or a part thereof, wherein the plant or part thereof comprises EVs;
 - (b) isolating a crude PMP fraction from the initial sample, wherein the crude PMP fraction has a decreased level of at least one contaminant or undesired component from the plant or part thereof relative to the level in the initial sample;

(c) purifying the crude PMP fraction, thereby producing a plurality of pure PMPs, wherein the plurality of pure PMPs have a decreased level of at least one contaminant or undesired component from the plant or part thereof relative to the level in the crude EV fraction;

(d) loading the plurality of PMPs of step (c) with a pathogen control agent; and

(e) formulating the PMPs of step (d) for delivery to an agricultural or veterinary animal pathogen or a vector thereof.

40. An animal pathogen comprising the pathogen control composition of claim 1.
41. An animal pathogen vector comprising the pathogen control composition of claim 1.
42. A method of delivering a pathogen control composition to an animal comprising administering to the animal the composition of claim 1.
43. A method of treating an infection in an animal in need thereof, the method comprising administering to the animal an effective amount of the composition of claim 1.
44. A method of preventing an infection in an animal at risk thereof, the method comprising administering to the animal an effective amount of the composition of claim 1, wherein the method decreases the likelihood of the infection in the animal relative to an untreated animal.
45. The method of claim 42, wherein the infection is caused by a pathogen, and the pathogen is a bacterium, a fungus, a virus, a parasitic insect, a parasitic nematode, or a parasitic protozoan.
46. The method of claim 45, wherein the bacterium is a *Pseudomonas* species, an *Escherichia* species, a *Streptococcus* species, a *Pneumococcus* species, a *Shigella* species, a *Salmonella* species, or a *Campylobacter* species.
47. The method of claim 45, wherein the fungus is a *Saccharomyces* species or a *Candida* species.
48. The method of claim 45, wherein the parasitic insect is a *Cimex* species.
49. The method of claim 45, wherein the parasitic nematode is a *Heligmosomoides* species.
50. The method of claim 45, wherein the parasitic protozoan is a *Trichomonas* species.
51. The method of claim 42, wherein the pathogen control composition is administered to the animal orally, intravenously, or subcutaneously.
52. A method of delivering a pathogen control composition to a pathogen comprising contacting the pathogen with the composition of claim 1.

53. A method of decreasing the fitness of a pathogen, the method comprising delivering to the pathogen the composition of claim 1, wherein the method decreases the fitness of the pathogen relative to an untreated pathogen.
54. The method of claim 52, wherein the method comprises delivering the composition to at least one habitat where the pathogen grows, lives, reproduces, feeds, or infests.
55. The method of claim 52, wherein the composition is delivered as a pathogen comestible composition for ingestion by the pathogen.
56. The method of claim 52, wherein the pathogen is a bacterium, a fungus, a parasitic insect, a parasitic nematode, or a parasitic protozoan.
57. The method of claim 56, wherein the bacterium is a *Pseudomonas* species, an *Escherichia* species, a *Streptococcus* species, a *Pneumococcus* species, a *Shigella* species, a *Salmonella* species, or a *Campylobacter* species.
58. The method of claim 56, wherein the fungus is a *Saccharomyces* species or a *Candida* species.
59. The method of claim 56, wherein the parasitic insect is a *Cimex* species.
60. The method of claim 56, wherein the parasitic nematode is a *Heligmosomoides* species.
61. The method of claim 56, wherein the parasitic protozoan is a *Trichomonas* species.
62. The method of claim 52, wherein the composition is delivered as a liquid, a solid, an aerosol, a paste, a gel, or a gas.
63. A method of decreasing the fitness of an animal pathogen vector, the method comprising delivering to the vector an effective amount of the composition of claim 1, wherein the method decreases the fitness of the vector relative to an untreated vector.
64. The method of claim 63, wherein the method comprises delivering the composition to at least one habitat where the vector grows, lives, reproduces, feeds, or infests.
65. The method of claim 63, wherein the composition is delivered as a comestible composition for ingestion by the vector.
66. The method of claim 63, wherein the vector is an insect.

67. The method of claim 66, wherein the insect is a mosquito, a tick, a mite, or a louse.
68. The method of claim 63, wherein the composition is delivered as a liquid, a solid, an aerosol, a paste, a gel, or a gas.
69. A method of treating an animal having a fungal infection, wherein the method comprises administering to the animal an effective amount of a pathogen control composition comprising a plurality of PMPs.
70. A method of treating an animal having a fungal infection, wherein the method comprises administering to the animal an effective amount of a pathogen control composition comprising a plurality of PMPs, and wherein the plurality of PMPs comprises an antifungal agent.
71. The method of claim 70, wherein the antifungal agent is a nucleic acid that inhibits expression of a gene in a fungus that causes the fungal infection.
72. The method of claim 71, wherein the gene is Enhanced Filamentous Growth Protein (EFG1).
73. The method of claim 70, wherein the fungal infection is caused by *Candida albicans*.
74. The method of claim 70, wherein the composition comprises a PMP derived from Arabidopsis.
75. The method of claim 70, wherein the method decreases or substantially eliminates the fungal infection.
76. A method of treating an animal having a bacterial infection, wherein the method comprises administering to the animal an effective amount of a pathogen control composition comprising a plurality of PMPs.
77. A method of treating an animal having a bacterial infection, wherein the method comprises administering to the animal an effective amount of a pathogen control composition comprising a plurality of PMPs, and wherein the plurality of PMPs comprises an antibacterial agent.
78. The method of claim 77, wherein the antibacterial agent is Amphotericin B.
79. The method of claim 77, wherein the bacterium is a *Pseudomonas* species, an *Escherichia* species, a *Streptococcus* species, a *Pneumococcus* species, a *Shigella* species, a *Salmonella* species, or a *Campylobacter* species.
80. The method of claim 77, wherein the composition comprises a PMP derived from Arabidopsis.

81. The method of claim 77, wherein the method decreases or substantially eliminates the bacterial infection.
82. The method of claim 69, wherein the animal is a veterinary animal, or a livestock animal.
83. A method of decreasing the fitness of a parasitic insect, wherein the method comprises delivering to the parasitic insect a pathogen control composition comprising a plurality of PMPs.
84. A method of decreasing the fitness of a parasitic insect, wherein the method comprises delivering to the parasitic insect a pathogen control composition comprising a plurality of PMPs, and wherein the plurality of PMPs comprise an insecticidal agent.
85. The method of claim 84, wherein the insecticidal agent is a peptide nucleic acid.
86. The method of claim 83, wherein the parasitic insect is a bedbug.
87. The method of claim 83, wherein the method decreases the fitness of the parasitic insect relative to an untreated parasitic insect.
88. A method of decreasing the fitness of a parasitic nematode, wherein the method comprises delivering to the parasitic nematode a pathogen control composition comprising a plurality of PMPs.
89. A method of decreasing the fitness of a parasitic nematode, wherein the method comprises delivering to the parasitic nematode a pathogen control composition comprising a plurality of PMPs, and wherein the plurality of PMPs comprises a nematocidal agent.
90. The method of claim 88, wherein the parasitic nematode is *Heligmosomoides polygyrus*.
91. The method of claim 88, wherein the method decreases the fitness of the parasitic nematode relative to an untreated parasitic nematode.
92. A method of decreasing the fitness of a parasitic protozoan, wherein the method comprises delivering to the parasitic protozoan a pathogen control composition comprising a plurality of PMPs.
93. A method of decreasing the fitness of a parasitic protozoan, wherein the method comprises delivering to the parasitic protozoan a pathogen control composition comprising a plurality of PMPs, and wherein the plurality of PMPs comprises an antiparasitic agent.
94. The method of claim 92, wherein the parasitic protozoan is *T. vaginalis*.

95. The method of claim 92, wherein the method decreases the fitness of the parasitic protozoan relative to an untreated parasitic protozoan.
96. A method of decreasing the fitness of an insect vector of an animal pathogen, wherein the method comprises delivering to the vector a pathogen control composition comprising a plurality of PMPs.
97. A method of decreasing the fitness of an insect vector of an animal pathogen, wherein the method comprises delivering to the vector a pathogen control composition comprising a plurality of PMPs, and wherein the plurality of PMPs comprises an insecticidal agent.
98. The method of claim 96, wherein the method decreases the fitness of the vector relative to an untreated vector.
99. The method of claim 96, wherein the insect is a mosquito, tick, mite, or louse.