Claims

1. A kit for stabilizing a population of nucleic acids within a biological cell, comprising:

at least one irreversible protein translation inhibitor;

at least one ribonucleic acid transcription inhibitor; and

at least one electron transport chain agent comprising an electron transport chain inhibitor and/or an electron transport chain decoupling agent;

wherein the at least one irreversible protein translation inhibitor is an aminoglycoside antibiotic, D-galactosamine, and/or emetine;

wherein the at least one ribonucleic acid transcription inhibitor is a CDK9 inhibitor, aurethricin, thiolutin, amanitin, and/or triptolide; and

wherein the at least one electron transport chain agent is rotenone, antimycin A1, 2-thenoyltrifluoroacetone, carboxin, cyanide, sodium azide, oligomycin, 2,4 dinitrophenol, dicumarol, and/or carbonylcyanide-4-(trifluoromethoxy)-phenylhydrazone.

2. The kit of claim 1, wherein the kit further comprises a second protein translation inhibitor.

3. The kit of claim 2, wherein the second protein translation inhibitor is a reversible protein translation inhibitor.

4. The kit of claim 2, wherein the second protein translation inhibitor is fast acting compared to the irreversible protein translation inhibitor.

5. The kit of any one of claims 2 to 4, wherein the second protein translation inhibitor is cell membrane permeable.

6. The kit of claim 2, wherein the second protein translation inhibitor is diazooxide, a glutarimide antibiotic, and/or an ipecac alkaloid.

7. The kit of claim 2, wherein the second protein translation inhibitor is cycloheximide.

8. The kit of any one of claims 1 to 7, wherein the at least one irreversible protein translation inhibitor is cell membrane permeable.

9. The kit of claim 8, wherein the at least one irreversible protein translation inhibitor comprises emetine.

10. The kit of any one of claims 1 to 7, wherein the at least one ribonucleic acid transcription inhibitor is cell membrane permeable.

11. The kit of claim 10, wherein the at least one ribonucleic acid transcription inhibitor comprises triptolide.

12. The kit of claim 10 or 11, wherein the at least one ribonucleic acid transcription inhibitor is an irreversible inhibitor.

13. The kit of claim 11, wherein the at least one ribonucleic acid transcription inhibitor further comprises a CDK9 inhibitor, aurethricin, thiolutin, and/or amanitin.

14. The kit of any one of claims 1 to 13, wherein the at least one electron transport chain agent has reversible activity.

15. The kit of any one of claims 1 to 14, wherein the at least one electron transport chain agent is cell membrane permeable.

16. The kit of claim 14 or 15, wherein the electron transport chain agent is an electron transport chain inhibitor.

17. The kit of any one of claims 14 to 16, wherein the electron transport chain agent comprises sodium azide.

18. The kit of any one of claims 1 to 17, wherein at least one of the at least one irreversible protein translation inhibitor, the at least one ribonucleic acid transcription inhibitor, and the at least one electron transport chain agent is provided in a solution.

19. The kit of any one of claims 1 to 18, wherein the kit does not comprise a RNase inhibitor.

20. The kit of any one of claims 1 to 19, wherein the kit further comprises a protease inhibitor.

21. The kit of any one of claims 1 to 20, wherein the kit further comprises a lysis buffer.

22. The kit of any one of claims 1 to 21, wherein more than one of the at least one irreversible protein translation inhibitor; the at least one ribonucleic acid transcription inhibitor; and the at least one electron transport chain agent are provided in a master mix.

23. A method of stabilizing a population of nucleic acids in a biological cell, comprising the steps of:

contacting the biological cell with at least one irreversible protein translation inhibitor; at least one ribonucleic acid transcription inhibitor; and at least one electron transport chain agent comprising an electron transport chain inhibitor and/or an electron transport chain decoupling agent,

wherein the contacting is performed for a period of time sufficient to stabilize the population of nucleic acids and thereby convert the biological cell to a stabilized biological cell;

wherein the at least one irreversible protein translation inhibitor is an aminoglycoside antibiotic, D-galactosamine, and/or emetine;

wherein the at least one ribonucleic acid transcription inhibitor is a CDK9 inhibitor, aurethricin, thiolutin, amanitin, and/or triptolide; and

wherein the electron transport chain agent is rotenone, antimycin A1, 2-thenoyltrifluoroacetone, carboxin, cyanide, sodium azide, oligomycin, 2,4 dinitrophenol, dicumarol, and/or carbonylcyanide-4-(trifluoromethoxy)-phenylhydrazone.

24. The method of claim 23, wherein the biological cell is simultaneously contacted with each of the at least one irreversible protein translation inhibitor, at least one ribonucleic acid transcription inhibitor, and at least one electron transport chain agent.

25. The method of claim 23 or 24, further comprising storing the stabilized biological cell in the presence of each of the at least one irreversible protein translation inhibitor, at least one ribonucleic acid transcription inhibitor, and at least one electron transport chain agent.

26. The method of claim 25, wherein the step of storing is performed for at least 8 hours.

27. The method of claim 25 or 26, wherein the step of storing is performed at a temperature of 0°C to 4°C.

28. The method of any one of claims 23 to 27, further comprising:

lysing the stabilized biological cell by contacting the stabilized biological cell with a lysis reagent.

29. The method of claim 28, further comprising isolating at least a portion of a stabilized population of nucleic acids released from the lysed stabilized biological cell.

30. The method of claim 29, further comprising analyzing at least one class of nucleic acid from the at least a portion of the stabilized population of nucleic acids released from the stabilized lysed biological cell.

31. The method of claim 30, wherein analyzing comprises sequencing the at least one class of nucleic acid.

32. The method of claim 31, wherein the at least one class of nucleic acid is ribonucleic acid.

33. A method of stabilizing a population of nucleic acids in a biological cell within a microfluidic device comprising an enclosure, comprising:

disposing the biological cell within the enclosure of the microfluidic device, wherein the enclosure comprises a flow region and at least one chamber and at least one chamber fluidically connected to the flow region, wherein the flow region and at least one chamber are configured to contain a fluidic medium; and

contacting the biological cell with at least one irreversible protein translation inhibitor; at least one ribonucleic acid transcription inhibitor; and at least one electron transport chain agent comprising an electron transport chain inhibitor and/or an electron transport chain decoupling agent;

wherein the contacting is performed for a period of time sufficient to stabilize the population of nucleic acids in the biological cell, and thereby convert the biological cell to a stabilized biological cell;

wherein the at least one irreversible protein translation inhibitor is an aminoglycoside antibiotic, D-galactosamine, and/or emetine;

wherein the at least one ribonucleic acid transcription inhibitor is a CDK9 inhibitor, aurethricin, thiolutin, amanitin, and/or triptolide; and

wherein the electron transport chain agent is rotenone, antimycin A1, 2-thenoyltrifluoroacetone, carboxin, cyanide, sodium azide, oligomycin, 2,4 dinitrophenol, dicumarol, and/or carbonylcyanide-4-(trifluoromethoxy)-phenylhydrazone.

34. The method of claim 33, wherein disposing the biological cell within the microfluidic device comprises disposing the biological cell within the at least one chamber.

35. The method of claim 33 or 34, wherein the at least one chamber comprises a sequestration pen having an isolation region and a connection region fluidically connecting the

isolation region to the flow region, wherein the isolation region and the connection region are configured such that components of the fluidic medium are exchanged between the flow region and the isolation region of the sequestration pen substantially only by diffusion.

36. The method of claim 35, wherein disposing the biological cell within the microfluidic device comprises disposing the biological cell within the isolation region of the sequestration pen.

37. The method of any one of claims 33 to 36, further comprising storing the stabilized biological cell in the microfluidic device.

38. The method of claim37, wherein the step of storing is performed for at least 8 hours.

39. The method of claim 37 or 38, wherein the step of storing is performed at a temperature of 0°C to 4°C.

40. The method of any one of claims 33 to 39, further comprising exporting the stabilized biological cell from the microfluidic device.

41. The method of any one of claims 23 to 40, wherein the biological cell is a mammalian cell.

42. The method of any one of claims 23 to 41, wherein the biological cell is an immunological cell.

43. The method of claim 42, wherein the immunological cell is a T cell, a B cell, a NK cell, and/or a macrophage.