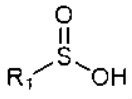
CLAIMS

WHAT IS CLAIMED IS:

1. A composition comprising (i) a nucleic acid molecule and (ii) a heterologous antioxidant moiety comprising a sulfinic acid group.

2. The composition of claim 1, wherein the heterologous antioxidant moiety has the structure:



, wherein R1 is C_1-C_6 alkylamine.

3. The composition of claim 1, wherein the heterologous antioxidant moiety is hypotaurine.

~~4. A composition comprising (i) a nucleic acid molecule and (ii) a heterologous antioxidant moiety comprising an oligomeric protein capable of inducing a decomposition of reactive oxygen species.~~

~~5. The composition of claim 4, wherein the oligomeric protein is a catalase.~~

~~6. The composition of claim 5, wherein the catalase has at least about 80%, 85%, 90%, 92%, 95%, 96%, 97%, 98%, 99%, or 100% sequence identity to SEQ ID NO. 1.~~

~~7~~4. The composition of any one of the preceding claims, wherein the heterologous antioxidant moiety reduces transversion of one or more nucleotides of the nucleic acid molecule.

~~8~~5. The composition of claim ~~7~~4, wherein the transversion comprises a purine to pyrimidine point mutation; optionally, wherein the transversion comprises a guanine to thymine point mutation, or vice versa.

~~9. The composition of claim 8, wherein the transversion comprises a guanine to thymine point mutation, or vice versa.~~

~~10~~6. The composition of ~~any of claims 7-9~~claim 4 or 5, wherein, when the composition is at about 47 ºC for about 8 hours, the composition experiences reduced transversion of the one or more nucleotides of the nucleic molecule by at least about 20%, 30%, 40%, 50%, or more as compared to a corresponding control composition that lacks the heterologous antioxidant moiety.

~~11~~7. The composition of any one of the preceding claims, wherein an amount of the heterologous antioxidant moiety in the composition is between about 0.1 millimolar and about 100 millimolar, between about 0.5 millimolar and about 50 millimolar; between about 1 millimolar and about 10 millimolar; between about 10 nanomolar and about 10 micromolar; about 100 nanomolar and about 1 micromolar; or between about 100 nanomolar and about 300 nanomolar.

~~12. The composition of claim 11, wherein the amount of the heterologous antioxidant moiety in the composition is between about 0.5 millimolar and about 50 millimolar.~~

~~13. The composition of claim 11, wherein the amount of the heterologous antioxidant moiety in the composition is between about 1 millimolar and about 10 millimolar.~~

~~14. The composition of any one of the preceding claims, wherein an amount of a population of nucleic acid molecules comprising the nucleic acid molecule in the composition is between about 10 nanomolar and about 10 micromolar.~~

~~15. The composition of claim 14, wherein the amount of the population of nucleic acid molecules in the composition is between about 100 nanomolar and about 1 micromolar.~~

~~16. The composition of claim 14, wherein the amount of the population of nucleic acid molecules in the composition is between about 100 nanomolar and about 300 nanomolar.~~

~~17~~8. The composition of any one of the preceding claims, comprising a plasma sample, wherein the plasma sample comprises the nucleic acid molecule.

~~18. The composition of any one of the preceding claims, comprising an isolated deoxyribonucleic acid (DNA) sample, wherein the isolated DNA sample comprises the nucleic acid molecule.~~

~~19~~9. The composition of any one of the preceding claims, comprising a nucleic acid analysis sample, wherein the nucleic acid analysis sample comprises the nucleic acid molecule.

~~20~~10. The composition of claim ~~19~~9, further comprising one or more nucleic acid probes designed to capture the nucleic acid molecule from a pool of nucleic acid molecules.

~~21. The composition of any one of the preceding claims, further comprising (1) a nucleic acid ligase, (2) a nucleic acid polymerase, or (3) a nucleic acid helicase for sequencing of at least a portion of the nucleic acid molecule.~~

~~22~~11. The composition of any one of the preceding claims, wherein the nucleic acid molecule is a cell-free nucleic acid molecule.

~~23~~12. The composition of any one of the preceding claims, wherein the composition is an ex vivo or in vitro composition.

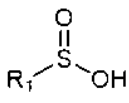
~~24~~13. The composition of any one of the preceding claims, wherein the nucleic acid molecule is from a biological sample from a subject.

~~25. The composition of claim 24, wherein the subject is a human subject.~~

~~26. The composition of claim 24, wherein the subject has been or is suspected of being exposed to more oxidative stress as compared to a control.~~

~~27~~14. A method comprising mixing (i) a nucleic acid molecule and (ii) a heterologous antioxidant moiety comprising a sulfinic acid group.

~~28~~15. The method of claim ~~27~~14, wherein the heterologous antioxidant moiety has the structure:



, wherein R1 is C_1-C_6 alkylamine.

1629. The method of claim 1527, wherein the heterologous antioxidant moiety is hypotaurine.

~~30. A method comprising mixing (i) a nucleic acid molecule and (ii) a heterologous antioxidant moiety comprising an oligomeric protein capable of inducing a decomposition of reactive oxygen species.~~

~~31. The method of claim 30, wherein the oligomeric protein is a catalase.~~

~~32. The method of claim 31, wherein the catalase has at least about 80%, 85%, 90%, 92%, 95%, 96%, 97%, 98%, 99%, or 100% sequence identity to SEQ ID NO. 1.~~

~~33. The method of any one of the preceding claims, wherein the heterologous antioxidant moiety reduces transversion of one or more nucleotides of the nucleic acid molecule.~~

~~34. The method of claim 33, wherein the transversion comprises a purine to pyrimidine point mutation.~~

~~35. The method of claim 34, wherein the transversion comprises a guanine to thymine point mutation.~~

~~36~~17. The method of ~~any of claims 33-35~~claim 16, wherein, upon subjecting a mixture comprising the nucleic acid molecule and the heterologous antioxidant moiety to at about 47 ºC for about 8 hours, the mixture experiences reduced transversion of the one or more nucleotides of the nucleic molecule by at least about 20%, 30%, 40%, 50%, or more as compared to a corresponding control composition that lacks the heterologous antioxidant moiety.

~~37. The method of any one of the preceding claims, wherein, upon the mixing, an amount of the heterologous antioxidant moiety is between about 0.1 millimolar and about 100 millimolar.~~

~~38. The method of claim 37, wherein, upon the mixing, an amount of the heterologous antioxidant moiety is between about 0.5 millimolar and about 50 millimolar.~~

~~39. The method of claim 37, wherein, upon the mixing, an amount of the heterologous antioxidant moiety is between about 1 millimolar and about 10 millimolar.~~

~~40. The method of any one of the preceding claims, wherein, upon the mixing, an amount of a population of nucleic acid molecules comprising the nucleic acid molecule in the mixture is between about 10 nanomolar and about 10 micromolar.~~

~~41. The method of claim 40, wherein the amount of the population of nucleic acid molecules in the mixture is between about 100 nanomolar and about 1 micromolar.~~

~~42. The method of claim 40, wherein the amount of the population of nucleic acid molecules in the mixture is between about 100 nanomolar and about 300 nanomolar.~~

~~43. The method of any one of the preceding claims, comprising mixing (i) a plasma sample that comprises the nucleic acid molecule and (ii) the heterologous antioxidant moiety comprising a sulfinic acid group.~~

~~44. The method of any one of the preceding claims, comprising mixing (i) an isolated deoxyribonucleic acid (DNA) sample that comprises the nucleic acid molecule and (ii) the heterologous antioxidant moiety comprising a sulfinic acid group.~~

~~45~~18. The method of any one of the preceding claims, wherein the nucleic acid molecule is a cell-free nucleic acid molecule.

~~46. The method of any one of the preceding claims, wherein the mixing is performed ex vivo or in vitro composition.~~

~~47. The method of any one of the preceding claims, wherein the nucleic acid molecule is from a biological sample from a subject.~~

~~48. The method of claim 47, wherein the subject is a human subject.~~

~~49. The method of claim 47, wherein the subject has been or is suspected of being exposed to more oxidative stress as compared to a control.~~

~~50. The method of any one of the preceding claims, further comprising storing a mixture comprising (i) the nucleic acid molecule and (ii) the heterologous antioxidant moiety for at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, or 7 days.~~

~~51~~19. The method of any one of the preceding claims, further comprising capturing the nucleic acid molecule via one or more nucleic acid probes prior to, concurrent with, or subsequent to the mixing.

~~52~~20. The method of any one of the preceding claims, further comprising, subsequent to the mixing, sequencing at least a portion of the nucleic acid molecule.

~~53. A device for holding a nucleic acid molecule, the device comprising a heterologous antioxidant moiety coupled to a surface of the device, wherein the heterologous antioxidant moiety comprises a sulfinic acid group.~~

~~54. A method to mitigate nucleotide transversions that arise during sequencing library preparation, comprising:~~

~~performing sequence library preparation with a reactive oxygen species scavenger or enzyme in the reaction mixture.~~

~~55. The method of claim 54, wherein the sequence capture reaction is performed with the reactive oxygen species scavenger hypotaurine in the reaction mixture.~~

~~56. The method of claim 54 or 55, wherein the reactive oxygen species scavenger is glutathione, hypotaurine, or sodium sulfite; and wherein the enzyme is uracil-DNA glycosylase (UDG), Formamidopyrimidine [fapy]-DNA glycosylase (FPG), or catalase enzyme.~~