CLAIMS

We claim:

1. An engineered pantothenate kinase polypeptide comprising ~~a polypeptide~~ an amino acid sequence having at least 85%~~, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more~~ sequence identity to SEQ ID NO: 2, ~~SEQ ID NO: 30, SEQ ID NO: 60, SEQ ID NO: 132, SEQ ID NO: 222, SEQ ID NO: 230, SEQ ID NO: 240, and/or SEQ ID NO: 276,~~ or to a functional fragment thereof, wherein said ~~engineered pantothenate kinase~~ polypeptide or fragment thereof comprises ~~at least one~~ an amino acid substitution ~~or substitution set in said polypeptide sequence, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 2, SEQ ID NO: 30, SEQ ID NO: 60, SEQ ID NO: 132, SEQ ID NO: 222, SEQ ID NO: 230, SEQ ID NO: 240, and/or SEQ ID NO: 276~~ corresponding to amino acid position 277 and/or 281 in SEQ ID NO: 2, wherein said polypeptide has increased ability to convert ethynyl glyceraldehyde to ethynyl glyceraldehyde phosphate when compared the wild-type polypeptide having the amino acid sequence SEQ ID NO: 2.

~~2. The engineered pantothenate kinase of Claim 1, comprising a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 2, or a functional fragment thereof, wherein said engineered pantothenate kinase comprises at least one substitution or substitution set in said polypeptide sequence, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 2.~~

2. The polypeptide of Claim 1, wherein the amino acid substitution is L277M or L277I.

3. The ~~engineered pantothenate kinase~~ polypeptide of Claim ~~2~~1, wherein ~~said engineered pantothenate kinase comprises a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 2, or a functional fragment thereof, and wherein said engineered pantothenate kinase comprises at least one~~ the amino acid substitution ~~or substitution set at one or more~~ is at both amino acid positions ~~selected from~~ 277 and ~~/~~281~~, 54/240/277/281, 240, 240/277, 240/277/281, 240/277/281/282, 240/281, and 240/281/282, 277, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 2~~.

~~4. The engineered pantothenate kinase of Claim 1, comprising a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%,~~

~~or more sequence identity to SEQ ID NO: 30, or a functional fragment thereof, wherein said engineered pantothenate kinase comprises at least one substitution or substitution set in said polypeptide sequence, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 30.~~

4. The polypeptide of Claim 3, wherein the amino acid substitution is L277I/I281L, L277M/1281M, or L277I/I281 M.

5. The polypeptide of Claim 4, wherein the mutation is L277I/I281 M.

~~5~~6. The ~~engineered pantothenate kinase~~ polypeptide of Claim ~~2~~5, wherein ~~said engineered pantothenate kinase comprises a~~ the polypeptide ~~sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 30, or a functional fragment thereof, and wherein said engineered pantothenate kinase~~ further comprises ~~at least one~~ amino acid substitutions ~~or substitution set at one or more positions~~ selected from the group consisting of amino acid position 13, 13/14/19/22, 13/14/22, 13/14/22/37, 13/14/22/106/247, 13/14/218/247/305, 13/19, 13/22, 15/26/283, 15/27, 15/27/283, 15/27/283/305, 15/27/305, 15/283, 19/22/26/69, 19/29, 20, 20/24, 20/24/25/69/75, 20/24/30/75, 20/70/75, 22/218, 22/218/271, 24, 24/30, 24/30/75, 24/75/86/134, 26, 26/29, 27, 27/78, 27/78/123/283, 27/283, 29, and 75~~, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 30~~.

~~6. The engineered pantothenate kinase of Claim 1, comprising a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 60, or a functional fragment thereof, wherein said engineered pantothenate kinase comprises at least one substitution or substitution set in said polypeptide sequence, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 60.~~

7. The polypeptide of Claim 6, wherein the amino acid substitutions is F15L/V27N/L277I/I281M/W283H.

~~7~~8. The ~~engineered pantothenate kinase~~ polypeptide of Claim ~~2~~7, ~~wherein said engineered pantothenate kinase comprises a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 60, or a functional fragment thereof, and~~ wherein ~~said engineered pantothenate kinase~~ the polypeptide further comprises ~~at least one~~ amino acid substitutions ~~or substitution set at one or~~

~~more~~ selected from the group consisting of amino acid positions ~~selected from~~ 14/19/41/157/161/261, 19/22/41/44/54/119/157/261/298/308, 19/22/54/157/169, 22/106/218, 41, 41/44/54/119/120/157/169/261, 41/44/54/119/120/157/261/298/308, 41/44/54/119/120/161/169/261/298, 41/44/54/119/298/305, 41/44/161/169/261, 41/44/169/261/298/308, 41/44/169/261/308, 41/54/119/157/169/261, 41/119/161/169/261/308, 41/119/161/308, 44/54/119/120/157/161/169, 44/54/119/120/157/161/261, 44/54/119/120/169/261, 44/54/119/157/161/261/298, 44/54/119/169, 44/76/119/157/161, 44/119/120/261, 44/119/157/161, 44/119/161/261/298, 44/157/161/169, 44/157/298, 44/261/298/308, 44/261/308, 54/119/157/161/169, 54/157/161/261/308, 119/157/161, 119/157/161/169/261, 119/169/261, 119/261/298/308, 120/157/261, 157, 157/161/169/261, 157/161/308, 157/169/261/298/308, 157/308, 250, 302, and 310~~, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 60~~.

~~8. The engineered pantothenate kinase of Claim 1, comprising a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 132, or a functional fragment thereof, wherein said engineered pantothenate kinase comprises at least one substitution or substitution set in said polypeptide sequence, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 132.~~

9. The polypeptide of Claim 8, wherein the amino acid substitutions is F15L/V27N/I54V/V157M/S161K/N261G/L277I/I281 M/W283H/A308I.

~~9~~10. The ~~engineered pantothenate kinase~~ polypeptide of Claim ~~2~~9, ~~wherein said engineered pantothenate kinase comprises a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 132, or a functional fragment thereof, and~~ wherein ~~said engineered pantothenate kinase~~ the polypeptide further comprises ~~at least one~~ amino acid substitutions ~~or substitution set at one or more positions~~ selected from the group consisting of amino acid positions 24/48, 64, 71, 123, 125, 134, and 180~~, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 132~~.

~~10. The engineered pantothenate kinase of Claim 1, comprising a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 132, or a functional fragment thereof, wherein said engineered pantothenate kinase comprises at least one substitution or substitution set in said polypeptide sequence, and wherein the amino acid positions of said polypeptide sequence are~~

~~numbered with reference to SEQ ID NO: 132.~~

~~11. The engineered pantothenate kinase of Claim 2, wherein said engineered pantothenate kinase comprises a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 132, or a functional fragment thereof, and wherein said engineered pantothenate kinase comprises at least one substitution or substitution set at one or more positions selected from 92/301, 125, and 180, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 132.~~

~~12. The engineered pantothenate kinase of Claim 1, comprising a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 222, or a functional fragment thereof, wherein said engineered pantothenate kinase comprises at least one substitution or substitution set in said polypeptide sequence, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 222.~~

11. The polypeptide of Claim 10, wherein the amino acid substitutions is F15L/V27N/154V/L123H/V157M/S161K/N261 G/L277I/I281 M/W283H/A308I.

~~13~~12. The ~~engineered pantothenate kinase~~ polypeptide of Claim ~~2~~11, ~~wherein said engineered pantothenate kinase comprises a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 222, or a functional fragment thereof, and~~ wherein ~~said engineered pantothenate kinase~~ the polypeptide further comprises ~~at least one~~ amino acid substitutions ~~or substitution set at one or more positions~~ selected from the group consisting of amino acid positions 83/84/305, 143, and 154~~, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 222~~.

~~14. The engineered pantothenate kinase of Claim 1, comprising a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 230, or a functional fragment thereof, wherein said engineered pantothenate kinase comprises at least one substitution or substitution set in said polypeptide sequence, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 230.~~

13. The polypeptide of Claim 12, wherein the amino acid substitutions is

F15L/V27N/154V/L123H/K143G/V157M/S161K/N261G/L277I/I281M/W283H/A308I.

~~15~~14. The ~~engineered pantothenate kinase~~ polypeptide of Claim ~~2~~13, ~~wherein said engineered pantothenate kinase comprises a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 230, or a functional fragment thereof, and~~ wherein ~~said engineered pantothenate kinase~~ the polypeptide further comprises ~~at least one~~ amino acid substitutions ~~or substitution set at one or more positions~~ selected from the group consisting of amino acid positions 13/169/213/247/283/288, 16/247, 49/247, 64/104/154/284, 75/104/284, 169/247, and 247~~, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 230~~.

~~16. The engineered pantothenate kinase of Claim 1, comprising a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 240, or a functional fragment thereof, wherein said engineered pantothenate kinase comprises at least one substitution or substitution set in said polypeptide sequence, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 240.~~

15. The polypeptide of Claim 14, wherein the amino acid substitutions is F15L/V27N/154V/V75Q/T104F/L123H/K143G/V157M/S161K/N261G/L277I/I281M/W283H/L284V/A308I.

~~17~~16. The ~~engineered pantothenate kinase~~ polypeptide of Claim ~~2~~15, ~~wherein said engineered pantothenate kinase comprises a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 240, or a functional fragment thereof, and~~ wherein ~~said engineered pantothenate kinase~~ the polypeptide further comprises ~~at least one~~ amino acid substitutions ~~or substitution set at one or more positions~~ selected from the group consisting of amino acid positions 8, 8/13/14/83/247, 8/64/213/247, 8/64/247, 8/247/283, 10, and 264/276~~, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 240~~.

~~18. The engineered pantothenate kinase of Claim 1, comprising a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 276, or a functional fragment thereof, wherein said engineered pantothenate kinase comprises at least one substitution or substitution set in said polypeptide sequence, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 276.~~

17. The polypeptide of Claim 16, wherein the amino acid substitutions is L8E/F15L/V27N/I54V/V75Q/T104F/L123H/K143G/V157M/S161K/F247L/N261G/L277I/I281M/H283S/L284V/A308I.

~~19~~18. The ~~engineered pantothenate kinase~~ polypeptide of Claim ~~2~~17, ~~wherein said engineered pantothenate kinase comprises a polypeptide sequence having at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 276, or a functional fragment thereof, and~~ wherein ~~said engineered pantothenate kinase~~ the polypeptide further comprises ~~at least one~~ amino acid substitutions ~~or substitution set at one or more positions~~ selected from the group consisting of amino acid positions 11/13/23/61/85/304, 13/19/61, 23/61, and 23/61/304~~, and wherein the amino acid positions of said polypeptide sequence are numbered with reference to SEQ ID NO: 276~~.

~~20. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a polypeptide sequence that is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% or more identical to the sequence of at least one engineered pantothenate kinase variant set forth in Table 2-1, 4-1, 5-1, 6-1, 6-2, 7-1, 8-1, 9-1, and/or Table 10-1.~~

~~21. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a polypeptide sequence that is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% or more identical to SEQ ID NO: 2.~~

~~22. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a variant engineered polypeptide set forth in SEQ ID NO: 2.~~

~~23. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a polypeptide sequence that is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% or more identical to SEQ ID NO: 30.~~

~~24. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a variant engineered polypeptide set forth in SEQ ID NO: 30.~~

~~25. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a polypeptide sequence that is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% or more identical to SEQ ID NO: 60.~~

~~26. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a variant engineered polypeptide set forth in SEQ ID NO: 60.~~

~~27. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a polypeptide sequence that is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% or more identical to SEQ ID NO: 132.~~

~~28. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a variant engineered polypeptide set forth in SEQ ID NO: 132.~~

~~29. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a polypeptide sequence that is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% or more identical to SEQ ID NO: 222.~~

~~30. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a variant engineered polypeptide set forth in SEQ ID NO: 222.~~

~~31. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a polypeptide sequence that is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% or more identical to SEQ ID NO: 230.~~

~~32. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a variant engineered polypeptide set forth in SEQ ID NO: 230.~~

~~33. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a polypeptide sequence that is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% or more identical to SEQ ID NO: 240.~~

~~34. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a variant engineered polypeptide set forth in SEQ ID NO: 240.~~

~~35. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a polypeptide sequence that is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% or more identical to SEQ ID NO: 276.~~

~~36. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a variant engineered polypeptide set forth in SEQ ID NO: 276.~~

~~37. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a polypeptide sequence that is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% or more identical to the sequence of at least one engineered pantothenate kinase variant set forth in the even numbered sequences of SEQ ID NOS: 2-270.~~

~~38. The engineered pantothenate kinase of Claim 1, wherein said engineered pantothenate kinase comprises a polypeptide sequence forth in the even numbered sequences of SEQ ID NOS: 2-270.~~

~~39. The engineered pantothenate kinase of any of Claims 1-38, wherein said engineered pantothenate kinase comprises at least one improved property compared to wild-type *E. coli* pantothenate kinase.~~

~~40. The engineered pantothenate kinase of Claim 39, wherein said improved property comprises improved activity on a substrate, as compared to a wild-type pantothenate kinase.~~

~~41. The engineered pantothenate kinase of Claim 40, wherein said substrate comprises 2,4-dinitrophenylhydrazine and at least one aldehyde.~~

~~42. The engineered pantothenate kinase of Claim 39, wherein said improved property comprises improved production of phospho-ethynyl glyceraldehyde, as compared to a wild-type pantothenate kinase.~~

~~43. The engineered pantothenate kinase of any of Claims 1-42, wherein said engineered pantothenate kinase is purified.~~

~~44~~19. A composition comprising ~~at least one~~ the engineered pantothenate kinase of ~~any of~~ Claims ~~1-43~~.

~~46~~20. A polynucleotide sequence encoding ~~at least one~~ an engineered pantothenate kinase polypeptide, wherein said polynucleotide sequence comprises at least 85%~~, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more~~ sequence identity to SEQ ID NO: 1, ~~SEQ ID NO: 29, SEQ ID NO: 59, SEQ ID NO: 131, SEQ ID NO: 221, SEQ ID NO: 229, SEQ ID NO: 239, and/or SEQ ID NO: 275,~~ wherein the polynucleotide sequence ~~of said~~

~~engineered pantothenate kinase comprises at least one substitution at one or more positions~~encodes the polypeptide of Claim 1.

~~45~~21. A polynucleotide sequence encoding ~~at least one~~ the engineered pantothenate kinase of ~~any of~~ Claim~~s~~ 1~~-43~~.

~~47. The polynucleotide sequence of Claim 46, encoding at least one engineered pantothenate kinase comprising at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 1, or a functional fragment thereof.~~

~~48. The polynucleotide sequence of Claim 46, encoding at least one engineered pantothenate kinase comprising at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 29, or a functional fragment thereof.~~

~~49. The polynucleotide sequence of Claim 46, encoding at least one engineered pantothenate kinase comprising at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 59, or a functional fragment thereof.~~

~~50. The polynucleotide sequence of Claim 46, encoding at least one engineered pantothenate kinase comprising at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 131, or a functional fragment thereof.~~

~~51. The polynucleotide sequence of Claim 46, encoding at least one engineered pantothenate kinase comprising at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 221, or a functional fragment thereof.~~

~~52. The polynucleotide sequence of Claim 46, encoding at least one engineered pantothenate kinase comprising at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 229, or a functional fragment thereof.~~

~~53. The polynucleotide sequence of Claim 46, encoding at least one engineered pantothenate kinase comprising at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 239, or a functional fragment thereof.~~

~~54. The polynucleotide sequence of Claim 46, encoding at least one engineered pantothenate kinase comprising at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or more sequence identity to SEQ ID NO: 275, or a functional fragment thereof.~~

~~55~~22. The polynucleotide sequence of ~~any of~~ Claim~~s 45-54~~21, wherein said polynucleotide sequence is operably linked to a control sequence.

~~56~~23. The polynucleotide sequence of ~~any of~~ Claim~~s 45-54~~21, wherein said polynucleotide sequence is ~~codon~~ radon optimized.

~~57. The polynucleotide sequence of any of Claims 45-56, wherein said polynucleotide comprises an odd-numbered sequence of SEQ ID NOS: 1-269.~~

~~58~~24. An expression vector comprising at least one polynucleotide sequence of ~~any of~~ Claim~~s 45-57~~21.

~~59~~25. A host cell comprising at least one expression vector of Claim ~~58~~24.

~~60~~26. A host cell comprising at least one polynucleotide sequence of ~~any of~~ Claim~~s 45-57~~21.

~~61~~27. A method of producing an engineered pantothenate kinase in a host cell, comprising culturing the host cell of Claim ~~59 and/or 60~~26, under suitable conditions, such that at least one engineered pantothenate kinase is produced.

~~62~~28. The method of Claim ~~61~~27, further comprising recovering at least one engineered pantothenate kinase from the culture and/or host cell.

~~63~~29. The method of Claim ~~61 and/or 62~~27, further comprising the step of purifying said at least one engineered pantothenate kinase.