

PRODUCTS, USES & METHODS

TECHNICAL FIELD

[0001] The invention relates to the production and use of Cas-encoding sequences and vectors comprising these. Aspects of the invention provide products, vectors, delivery vehicles, uses and methods for producing Cas-encoding sequences in bacterial or archaeal cells.

BACKGROUND

[0002] The state of the art describes vectors and uses of these that employ CRISPR/Cas systems. For example, reference is made to WO2017/118598, US20180140698, US20170246221, US20180273940, US20160115488, US20180179547, US20170175142, US20160024510, US20150064138, US20170022499, US20160345578, US20180155729, US20180200342, WO2017112620, WO2018081502, PCT/EP2018/066954, PCT/EP2018/066980, PCT/EP2018/071454 and USSN 15/985,658 and equivalent publications by the US Patent and Trademark Office (USPTO) or WIPO, the disclosures of which are incorporated herein by reference.

SUMMARY OF THE INVENTION

[0003] The invention provides the following configurations.

[0004] In a First Configuration

A nucleic acid vector for introduction into a host cell, the vector comprising a first nucleotide sequence encoding a Type I Cas3 and a second nucleotide sequence encoding one or more Cascade proteins, wherein the first and second sequences are under the control of one or more promoters comprised by the vector for expression of the proteins in the cell.

In an example, the vector comprises an operon for expression in the cell of the Cas3 and Cascade proteins from a Cas module, the module comprising the nucleotide sequences encoding the Cas3 and Cascade proteins, and the operon comprising the Cas module under the control of a promoter for controlling the expression of both the Cas3 and Cascade proteins.

The invention also provides a delivery vehicle comprising the vector, as well as a pharmaceutical composition comprising the vector or vehicle and a pharmaceutically acceptable diluent, excipient or carrier.

The invention also provides a method of treating or reducing the risk of a disease or condition in a human or animal subject, the method comprising administering the vector, vehicle or composition to the subject, and introducing the vector into target host bacterial or archaeal cells in the subject (eg, in

a gut microbiota, lung, eye or blood of the subject), wherein the Cas cuts (or otherwise modifies) one or more target sequences in the target cells and the cells are killed or growth or proliferation of the cells is reduced.

[0005] In a Second Configuration

A method of amplifying copies of a DNA encoding a functional Cas protein (optionally a Cas nuclease) in a bacterial or archaeal production strain of cells, the method comprising

- (a) Providing production strain cells, each cell comprising a copy of said DNA, wherein each DNA comprises a nucleotide sequence encoding said Cas, wherein the nucleotide sequence is under the control of a promoter for controlling the expression of the Cas in the production strain cell, the DNA comprising an origin of replication that is operable in the cell for replication of the DNA;
- (b) Culturing the cells to allow replication of the DNA, whereby the DNA is amplified; and
- (c) Optionally isolating copies of the DNA,

Optionally wherein the promoter is an attenuated constitutive promoter.

[0006] In a third Configuration

Use of an attenuated promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for enhancing the yield of amplified DNA produced by the production host cells.

[0007] In a fourth Configuration

Use of an attenuated promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for reducing toxicity of the Cas in the production strain.

[0008] In a fifth Configuration

Use of an attenuated promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for reducing mutation of the DNA (optionally the Cas-encoding sequence) in the

production strain.

[0009] In a sixth Configuration

Use of an attenuated promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for promoting production cell viability during the amplification of the DNA.

[00010] In a seventh Configuration

Use of an attenuated promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for reducing the occurrence of Cas cutting of DNA.

[00011] In an eighth Configuration

A method for enhancing the yield of amplified copies of a DNA construct in a population of bacterial or archaeal production strain cells, wherein the construct comprises a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated promoter.

[00012] In a ninth Configuration

A method for reducing toxicity of a functional Cas protein (optionally a Cas nuclease) in a population of bacterial or archaeal production strain cells in a process of amplifying copies of a DNA construct, wherein the construct comprises a nucleotide sequence encoding the Cas and the sequence is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated promoter.

[00013] In a tenth Configuration

A method for reducing mutation of a DNA construct encoding a functional Cas protein (optionally a Cas nuclease) in a population of bacterial or archaeal production strain cells in a process of amplifying copies of the construct, wherein the construct comprises a nucleotide sequence encoding the Cas and the sequence is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated promoter.

[00014] In an eleventh Configuration

A method for promoting production cell viability of a population of bacterial or archaeal production strain cells in a process of amplifying copies of a DNA construct comprised by the cells, wherein the construct comprises a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) and the sequence is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated promoter.

[00015] In a twelfth Configuration

A method for reducing the occurrence of Cas nuclease cutting of a DNA construct in a population of bacterial or archaeal production strain cells in a process of amplifying copies of the construct, wherein the construct comprises a nucleotide sequence encoding the Cas and the sequence is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated promoter.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1. Type I CRISPR-Cas system of *C. difficile* targeting *E. coli* MG1655. (A) Layout of the CRISPR Guided Vector™, CGV™. Plasmid 1: pSC101 ori, pBAD promoter (induced by arabinose), *cas3* and cascade genes. Plasmid 2: pCloDF13 ori, pTac promoter (induced by IPTG), CRISPR array. (B) Dilution series (10^1 – 10^6) of drop spots (5 μ l) of *E. coli* MG1655 harboring the CGV on LB agar plates with and without inducers. (C) CRISPR induction killed 99.9 % of the population (grey bar). Growth in absence of induction is shown in black. CGV™ refers to a CRISPR Guided Vector™, which is a nucleic acid vector comprising nucleotide sequences encoding CRISPR/Cas components.

Figure 2. Type I CRISPR-Cas system of *C. difficile* targeting *E. coli* MG1655. (A) Layout of the CRISPR Guided Vector™, CGV™. pSC101 ori, pTac promoter (induced by IPTG), CRISPR array, pBAD promoter (induced by arabinose), *cas3* and cascade genes. (B) Dilution series (10^1 – 10^6) of drop spots (5 μ l) of *E. coli* MG1655 harboring the CGV on SM agar plates with and without inducers. (C) CRISPR induction killed 99 % of the population (grey bar). Growth in absence of induction is shown in black. CGV™ refers to a CRISPR Guided Vector™, which is a nucleic acid vector comprising nucleotide sequences encoding CRISPR/Cas components.

Figure 3. Time-kill curves for *E. coli* MG1655 harboring the CGV. (A) CRISPR induction killed 99 % of the population in 60 minutes (dashed line). Growth in absence of induction is shown in black

lines. CRISPR/Cas was induced at time-point 0 and monitored until 120 minutes. (B) Dilution series (10^1 – 10^6) of drop spots (5 μ l) on SM agar plates of *E. coli* MG1655 after 60 minutes of induction.

Figure 4. Specific killing of *E. coli* MG1655 with type I-B CRISPR-Cas system of *C. difficile* in a synthetic microbial consortium. (A) Bacteria count of a synthetic population composed of three different strains. CRISPR was induced at time-point 0 and monitored for 60 minutes. Growth in absence of induction is shown in black. CRISPR induction prompted 1- $\log_{10}$ reduction in viable cells of target strain *E. coli* MG1655, while leaving *E. coli* Top10 and *L. lactis* NZ9000 populations intact (dark grey bars). (B) Dilution series (10^1 – 10^6) of drop spots (5 μ l) of the bacterial community mixture after 60 minutes of induction. *E. coli* MG1655 grows selectively on BHI+streptomycin, *E. coli* Top10 on ampicillin, and *L. lactis* NZ9000 on chloramphenicol.

Figure 5. Killing of *E. coli* MG1655 with type I-B CRISPR-Cas system of *C. difficile* in a synthetic microbial consortium compared to a pure culture of *E. coli* MG1655. (A) CRISPR induction generated 4- $\log_{10}$ reductions in viable cells of target strain *E. coli* MG1655, both in the pure culture and in the community mixture (grey bars). Growth in absence of induction is shown in black. (B) Dilution series of a pure culture of *E. coli* MG1655 and the bacterial community mixture on streptomycin plates with and without inducers.

DETAILED DESCRIPTION

[00016] The invention relates to the production and use of Cas-encoding sequences and vectors comprising these. Aspects of the invention provide products, vectors, delivery vehicles, uses and methods for producing Cas-encoding sequences in bacterial or archaeal cells.

[00017] An aspect of the invention provides for the control of expression of Cas and optionally also Cascade proteins from single vectors, such as by regulated use of Cas modules in an operon and/or using attenuated promoters.

[00018] CONCEPTS:

An aspect of the invention provides nucleic acid vectors that are useful for introducing into target host cells of any eukaryotic or prokaryotic species (eg, *ex vivo* or *in vitro*) for expressing Type I Cas and optionally other components of a Type I CRISPR/Cas system. Usefully, the vector may in some examples therefore provide a single-vector means for introducing a complete exogenous Type I CRISPR/Cas system into a target cell for modification (eg, cutting by Cas3) of DNA in the target cell. In an example, a chromosomal target sequence (ie, protospacer that is cognate with the Cas3) is

modified. In another example, an episomal DNA sequence is modified, for example a plasmid sequence or a DNA that has been introduced into the cell. The latter may be useful in a recombineering method of the invention wherein exogenous DNA in the target cell is cut by the Cas3 and optionally this produces one or more recombinogenic ends for recombination of the cut DNA with a further DNA of interest, thereby producing a recombination product in the cell. For example, in such a recombineering method, the target cell is a recombinogenic *E coli* cell, eg, comprising a red/ET system. In another example, the target cell is an undesired cell (eg, a cell of a species or strain that is pathogenic to humans or animals, such as a bacterial disease-causing species or strain) and the cutting by Cas3 kills the cell. This may be useful for treating or preventing an infection in a human or animal harbouring target cells. The provision of single-vector means that express minimally a Cas endonuclease (eg, Cas3), cognate accessory proteins (eg, Cascade proteins) and at least one CRISPR array (or nucleotide sequence encoding a guide RNA (eg, a single guide RNA)), wherein the Cas, accessory proteins and array (or nucleotide sequence) comprise a functional CRISPR/Cas system is more convenient and the inventors believe more efficient for introducing into a target cell and effecting CRISPR/Cas modification of a target sequence therein than the use of 2 or 3 or more separate vectors (eg, a vector encoding the Cas nuclease and a different vector encoding the accessory proteins, and possibly a further vector comprising the array (or gRNA-encoding nucleotide sequence) which all need to transform the target cell for the system to function). This may provide one or more benefits, therefore, such as simplifying delivery (and thus the design of delivery vehicles), simplifying construction of the vector and vehicle and/or providing for better cutting or killing efficiencies. Conveniently, an example of the invention therefore uses an operon for the coordinated expression in the target cells of the Cas and accessory proteins (and optionally also the array or gRNA-encoding sequence(s)). Whilst not wishing to be bound by any particular theory, the introduction of a single vector (eg, using an operon) as per the invention may advantageously coordinate the expression of the Cas and accessory proteins (and optionally production of cRNAs or gRNAs) so that these are available to operate together without undue delay in the target cell. This may be important to tip the balance between, on the one hand the target cell using its endogenous anti-restriction, endogenous Cas or other endogenous mechanisms that seek out and degrade invading phage and DNA, and on the other hand efficient cell killing or deactivation of such mechanisms by the invading CRISPR components of the vector of the invention. In such an arms race, concerted and early operation of the CRISPR components in the cell are likely to be important to gain the upper hand and effect cell killing. The invention provides means to assist this.

By way of example, the invention thus provides the following Concepts:-

1. A nucleic acid vector for introduction into a host cell, the vector comprising a first nucleotide sequence encoding a Type I Cas3 and a second nucleotide sequence encoding one or more Cascade proteins, wherein the first and second sequences are under the control of one or more

promoters comprised by the vector for expression of the proteins in the cell.

2. The vector of concept 1, wherein the vector comprises an operon for expression in the cell of the Cas3 and Cascade proteins from a Cas module, the module comprising the nucleotide sequences encoding the Cas3 and Cascade proteins, and the operon comprising the Cas module under the control of a promoter for controlling the expression of both the Cas3 and Cascade proteins.
3. The vector of concept 2, wherein
 - (a) the first sequence is between the promoter and the second sequence in the operon;
 - (b) the operon comprises no Cas-encoding nucleotide sequences between the promoter and the first nucleotide sequence; and/or
 - (c) the operon comprises (in 5' to 3' direction) the promoter, the first sequence and the second sequence.
4. The vector of any preceding concept, wherein each promoter is a constitutive promoter.
5. The vector of any one of concepts 1 to 3, wherein the promoter is repressible (optionally repressible by a tetracycline repressor or lac repressor).
6. The vector of any one of concepts 1 to 3, wherein the promoter is inducible.
7. The vector of any preceding concept, wherein the first sequence is under the control of a medium strength promoter.
8. The vector of any preceding concept, wherein the first sequence is under the control of a promoter that has an Anderson Score (AS) of $0.5 > AS > 0.1$.
9. The vector of any preceding concept, wherein the first sequence (and optionally the second sequence) is under the control of a promoter and translation initiation site (TIS) combination that is capable of producing expression of green fluorescent protein (GFP) from a first expression operating unit (EOU) in *E. coli* strain BW25113 cells with a fluorescence of from 0.5 to 4 times the fluorescence produced in *E. coli* strain BW25113 cells using a second EOU comprising a P10 promoter (SEQ ID NO: 1) combined with a BCD14 TIS (SEQ ID NO: 2), wherein the EOUs differ only in their promoter and TIS combinations, wherein each EOU comprises (in 5' to 3' direction) an upstream initiator, the respective promoter, the respective TIS, a nucleotide sequence encoding GFP, a 3' UTR, a transcription terminator and a downstream insulator.

10. The vector of concept 9, wherein fluorescence using the first EOU is 0.5 to 2 times the fluorescence using the second EOU.
11. The vector of any preceding concept, wherein the vector comprises an origin of replication that is operable in the host cell.
12. The vector of any preceding concept, wherein the vector comprises an origin of replication that is operable in a bacterial cell of a vector production strain, wherein the Cas3 is not operable in the production strain cell to target and cut a chromosomal sequence thereof.
13. The vector of concept 12, wherein the first sequence is under the control of a promoter that is capable of controlling expression of the Cas3 at a level that is not toxic to the production strain cell.
14. The vector of any preceding concept, wherein the vector is a high copy number vector.
15. The vector of any preceding concept, wherein the first nucleotide sequence or operon is comprised by a mobile genetic element.
16. The vector of any preceding concept, wherein the vector is devoid of a Cas adaption module.
17. The vector of any preceding concept, wherein the vector is devoid of nucleotide sequence encoding one, more or all of a Cas1, Cas2, Cas4, Cas6, Cas7 and Cas 8.
18. The vector of any preceding concept, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas11, Cas7 and Cas8a1.
19. The vector of concept 18, wherein the vector comprises nucleotide sequence encoding Cas3' and/or Cas3''.
20. The vector or concept 19, wherein the nucleotide sequences encoding the Cas3' and/or Cas3'' are between the promoter and the sequence(s) recited in concept 18.
21. The vector of any one of concepts 18 to 20, wherein the host cell comprises a Type IA CRISPR array that is cognate with the Cas3.

22. The vector of any one of concepts 18 to 20, wherein the host cell comprises an endogenous Type IB, C, U, D, E or F CRISPR/Cas system.
23. The vector of any one of concepts 1 to 17, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8b1, Cas7 and Cas5.
24. The vector of concept 23, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in concept 23.
25. The vector of concept 23 or 24, wherein the host cell comprises a Type IB CRISPR array that is cognate with the Cas3.
26. The vector of concept 23 or 24, wherein the host cell comprises an endogenous Type IA, C, U, D, E or F CRISPR/Cas system.
27. The vector of any one of concepts 1 to 17, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas5, Cas8c and Cas7.
28. The vector of concept 27, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in concept 27.
29. The vector of concept 27 or 28, wherein the host cell comprises a Type IC CRISPR array that is cognate with the Cas3.
30. The vector of concept 27 or 28, wherein the host cell comprises an endogenous Type IA, B, U, D, E or F CRISPR/Cas system.
31. The vector of any one of concepts 1 to 17, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8U2, Cas7, Cas5 and Cas6.
32. The vector of concept 31, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in concept 31.
33. The vector of concept 31 or 32, wherein the host cell comprises a Type IU CRISPR array that is cognate with the Cas3.

34. The vector of concept 31 or 32, wherein the host cell comprises an endogenous Type IA, B, C, D, E or F CRISPR/Cas system.
35. The vector of any one of concepts 1 to 17, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas10d, Cas7 and Cas5.
36. The vector of concept 35, wherein the vector comprises a nucleotide sequence encoding Cas3' and/or Cas3''.
37. The vector of concept 36, wherein the nucleotide sequences encoding the Cas3' and/or Cas3'' are between the promoter and the sequence(s) recited in concept 35.
38. The vector of any one of concepts 35 to 37, wherein the host cell comprises a Type ID CRISPR array that is cognate with the Cas3.
39. The vector of any one of concepts 35 to 37, wherein the host cell comprises an endogenous Type IA, B, C, U, E or F CRISPR/Cas system.
40. The vector of any one of concepts 1 to 17, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8e, Cas11, Cas7, Cas5 and Cas6.
41. The vector of concept 40, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in concept 40.
42. The vector of concept 40 or 41, wherein the host cell comprises a Type IE CRISPR array that is cognate with the Cas3.
43. The vector of concept 40 or 41, wherein the host cell comprises an endogenous Type IA, B, C, D, U or F CRISPR/Cas system.
44. The vector of any one of concepts 1 to 17, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8f, Cas5, Cas7 and Cas6f.
45. The vector of concept 44, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in concept 44, wherein the vector is devoid of nucleotide sequence encoding further Cas between the promoter and the sequence encoding the

Cas3.

46. The vector of concept 44 or 45, wherein the host cell comprises a Type IF CRISPR array that is cognate with the Cas3.
47. The vector of concept 44 or 45, wherein the host cell comprises an endogenous Type IA, B, C, D, U or E CRISPR/Cas system.
48. The vector of any one of concepts 1 to 17, wherein the Cas and Cascade are
- (a) Type IA Cas and Cascade proteins;
 - (b) Type IB Cas and Cascade proteins;
 - (c) Type IC Cas and Cascade proteins;
 - (d) Type ID Cas and Cascade proteins;
 - (e) Type IE Cas and Cascade proteins;
 - (f) Type IF Cas and Cascade proteins; or
 - (g) Type IU Cas and Cascade proteins.
49. The vector of any preceding concept, wherein the Cas and Cascade are *E. coli* (optionally Type IE or IF) Cas and Cascade proteins.
50. The vector of concept 49, wherein the *E. coli* is ESBL-producing *E. coli* or *E. coli* ST131-O25b:H4.
51. The vector of any preceding concept, wherein the Cas and Cascade are
- (a) *Clostridium* (eg, *C. difficile*) Cas and Cascade proteins, optionally *C. difficile* resistant to one or more antibiotics selected from aminoglycosides, lincomycin, tetracyclines, erythromycin, clindamycin, penicillins, cephalosporins and fluoroquinolones;
 - (b) *Pseudomonas aeruginosa* Cas and Cascade proteins, optionally *P. aeruginosa* resistant to one or more antibiotics selected from carbapenems, aminoglycosides, cefepime, ceftazidime, fluoroquinolones, piperacillin and tazobactam; or
 - (c) *Klebsiella pneumoniae* (eg, carbapenem-resistant *Klebsiella pneumoniae* or Extended-Spectrum Beta-Lactamase (ESBL)-producing *K. pneumoniae*) Cas and Cascade proteins.
52. The vector of any preceding concept, wherein the Cas and Cascade are *E. coli*, *C. difficile*, *P. aeruginosa*, *K. pneumoniae*, *P. furiosus* or *B. halodurans* Cas and Cascade proteins.

53. The vector of any preceding concept, wherein the Cas3 is a Cas3 of a CRISPR/Cas locus of a first bacterial or archaeal species, wherein the distance between the Cas3-encoding sequence of the locus and its cognate promoter is further than the distance between the Cas3-encoding sequence and the respective promoter comprised by the vector.
54. The vector of any preceding concept, wherein the distance between the promoter and the Cas3-encoding sequence and/or Cascade protein-encoding sequence(s) is shorter than in a corresponding wild-type Type I locus.
55. The vector of any preceding concept, wherein the vector comprises (i) a CRISPR array for producing crRNAs in the host cell and/or (ii) one or more nucleotide sequences encoding one or more guide RNAs (gRNAs or single gRNAs), wherein the crRNAs or gRNAs are cognate to the Cas3 (and optionally cognate to the Cascade proteins).
56. The vector of concept 55 when dependent from concept 2, wherein the array or gRNA-encoding sequence(s) are comprised by the operon and under the control of the promoter.
57. The vector of concept 56, wherein the array or gRNA-encoding sequence(s) are under the control of a promoter that is different from the promoter that controls the expression of the Cas3.
58. The vector of concept 56 or 57, wherein one or more of the crRNAs or gRNAs comprises a spacer sequence that is capable of hybridising to a target nucleotide sequence of the host cell, wherein the target sequence is adjacent a PAM, the PAM being cognate to the Cas3.
59. The vector of concept 58, wherein the target sequence is a chromosomal sequence of the host cell.
60. The vector of concept 58 or 59, wherein the Cas3 is operable to cut the target sequence.
61. The vector of any preceding concept, wherein the vector is a plasmid or phagemid.
62. A delivery vehicle comprising the vector of any preceding concept, wherein the delivery vehicle is capable of delivering the vector into the host cell.
63. The vehicle of concept 62, wherein the delivery vehicle is a phage, non-replicative transduction particle, nanoparticle carrier, bacterium or liposome.

64. The vector or vehicle of any preceding concept, wherein the host cell is a bacterial or archaeal cell, optionally, the host cell is a *C difficile*, *P aeruginosa*, *K pneumoniae* (eg, carbapenem-resistant *Klebsiella pneumoniae* or Extended-Spectrum Beta-Lactamase (ESBL)-producing *K pneumoniae*), *E coli* (eg, ESBL-producing *E. coli*, or *E. coli* ST131-O25b:H4), *H pylori*, *S pneumoniae* or *S aureus* cell.
65. The vector or vehicle of any preceding concept for administration to a human or animal subject for treating or reducing the risk of a disease or condition in the subject.
66. The vector or vehicle of concept 65, wherein the disease or condition is an infection of the subject with host cells (eg, bacterial cells), or wherein the disease or condition is mediated by host cells (eg, bacterial cells).
67. A pharmaceutical composition comprising the vector or vehicle of any preceding concept and a pharmaceutically acceptable diluent, excipient or carrier.
68. A method of treating or reducing the risk of a disease or condition in a human or animal subject, the method comprising administering the vector, vehicle or composition of any preceding concept to the subject, and introducing the vector into target host bacterial or archaeal cells in the subject (eg, in a gut microbiota, lung, eye or blood of the subject), wherein the Cas cuts (or otherwise modifies) one or more target sequences in the target cells and the cells are killed or growth or proliferation of the cells is reduced.
69. The method of concept 68, wherein the target cells are cells of a disease pathogen species.
70. The method of concept 68 or 69, wherein the target cells are *C difficile*, *P aeruginosa*, *K pneumoniae* (eg, carbapenem-resistant *Klebsiella pneumoniae* or Extended-Spectrum Beta-Lactamase (ESBL)-producing *K pneumoniae*), *E coli* (eg, ESBL-producing *E. coli*, or *E. coli* ST131-O25b:H4), *H pylori*, *S pneumoniae* or *S aureus* cells.

[00019] EMBODIMENTS:

An aspect of the invention provides improved ways of amplifying DNA constructs in bacterial and archaeal production strain cells. For example, the DNA may be a high copy number plasmid or phagemid comprising a constitutive promoter for controlling the expression of one or more Cas proteins when the DNA has been introduced into a target host bacterial or host cell. It is desirable, according to an aspect of the invention, to consider attenuating the promoter activity during amplification of the DNA in the production strain. This is useful, since the inventors have found that

Cas expression in production strains may be toxic to production strain cells, thereby reducing the yield of amplified DNA. Toxicity may be due, for example, to off-target cutting of the production strain chromosomal DNA when the Cas is a nuclease (such as Cas9 or Cas3) and/or due to relatively high levels of expression of the Cas in the cells. Additionally or alternatively, undesirably the Cas expression or activity may impose a selective pressure that favours mutation and propagation of mutated DNA constructs (such as mutation in one more or all of a CRISPR/Cas operon, Cas-encoding gene, Cascade-encoding gene, CRISPR array and gRNA-encoding sequence of the DNA construct) in production cells, thereby reducing the yield of desired amplified constructs and imposing an undesired step of separating desired from mutated DNA constructs for further formulation into useful compositions.. Such compositions may be pharmaceutical compositions, herbicides, pesticides, environmental remediation compositions etc. In one example, the promoter attenuation in production strains is achieved by using a medium strength (not high or low) promoter to control the Cas-encoding nucleotide sequence of the DNA constructs. A medium level of Cas expression may be tolerable in the production strains, and yet once the DNA is subsequently introduced into target host cells the Cas is expressed at sufficiently high levels to produce desired activity to modify (eg, cut) target sequences in target cells. In an alternative, the invention uses a repressible promoter, wherein the promoter is repressed in production strain, but not repressed in target host cells. For example, aspects of the invention use a tetracycline repressor (tetR) expressed in production strain cells that represses the promoter.

[00020] Thus, the yield can be enhanced by one or more of

- (a) reducing toxicity of the Cas in the production strain;
- (b) reducing mutation of the DNA (optionally the Cas-encoding sequence) in the production strain;
- (c) promoting production cell viability during the amplification of the DNA; and
- (d) reducing the occurrence of Cas cutting of DNA (optionally cutting of production host cell chromosomal DNA or said DNA construct).

[00021] To this end, the invention provides Embodiments as follows:-

1. A method of amplifying copies of a DNA encoding a functional Cas protein (optionally a Cas nuclease) in a bacterial or archaeal production strain of cells, the method comprising
 - (a) Providing production strain cells, each cell comprising a copy of said DNA, wherein each DNA comprises a nucleotide sequence encoding said Cas, wherein the nucleotide sequence is under the control of a promoter for controlling the expression of the Cas in the production strain cell, the DNA comprising an origin of replication that is operable in the cell for replication of the DNA;
 - (b) Culturing the cells to allow replication of the DNA, whereby the DNA is amplified; and
 - (c) Optionally isolating copies of the DNA,

wherein the promoter is an attenuated constitutive promoter.

In an example, promoter is a medium strength promoter. In another example, the promoter is repressed in the production strain cell. Hence, the promoter is an attenuated promoter in these examples.

2. Use of an attenuated promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for enhancing the yield of amplified DNA produced by the production host cells.
3. The use of paragraph 2, wherein the use is for enhancing said yield by
 - (a) reducing toxicity of the Cas in the production strain;
 - (b) reducing mutation of the DNA (optionally the Cas-encoding sequence) in the production strain;
 - (c) promoting production cell viability during the amplification of the DNA; and/or
 - (d) reducing the occurrence of Cas cutting of DNA (optionally cutting of production host cell chromosomal DNA or said DNA construct).
4. Use of an attenuated promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for reducing toxicity of the Cas in the production strain.
5. Use of an attenuated promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for reducing mutation of the DNA (optionally the Cas-encoding sequence) in the production strain.
6. Use of an attenuated promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for promoting production cell viability during the amplification

of the DNA.

7. Use of an attenuated promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for reducing the occurrence of Cas cutting of DNA.
8. A method for enhancing the yield of amplified copies of a DNA construct in a population of bacterial or archaeal production strain cells, wherein the construct comprises a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated promoter.
9. A method for reducing toxicity of a functional Cas protein (optionally a Cas nuclease) in a population of bacterial or archaeal production strain cells in a process of amplifying copies of a DNA construct, wherein the construct comprises a nucleotide sequence encoding the Cas and the sequence is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated promoter.
10. A method for reducing mutation of a DNA construct encoding a functional Cas protein (optionally a Cas nuclease) in a population of bacterial or archaeal production strain cells in a process of amplifying copies of the construct, wherein the construct comprises a nucleotide sequence encoding the Cas and the sequence is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated promoter.
11. A method for promoting production cell viability of a population of bacterial or archaeal production strain cells in a process of amplifying copies of a DNA construct comprised by the cells, wherein the construct comprises a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) and the sequence is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated promoter.
12. A method for reducing the occurrence of Cas nuclease cutting of a DNA construct in a population of bacterial or archaeal production strain cells in a process of amplifying copies of the construct,

wherein the construct comprises a nucleotide sequence encoding the Cas and the sequence is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated promoter.

13. The use of paragraph 5 or 7, or the method of paragraph 10 or 12, wherein the mutation or cutting is mutation or cutting of host cell chromosomal DNA or the construct DNA.
14. The method or use of any one of paragraphs 2 to 13, wherein the promoter is a constitutive promoter.
15. The method or use of any preceding paragraph, wherein the promoter is repressed in the production strain cells (optionally repressed by a tetracycline repressor or a lac repressor).
16. The method or use of paragraph 15, wherein the promoter is $P_{LtetO-1}$, $P_{LlacO-1}$ or a repressible homologue thereof.

Other examples of suitable repressible promoters are P_{tac} (repressed by $lacI$) and the Leftward promoter (pL) of phage lambda (which repressed by the λcI repressor). In an example, the promoter comprises a repressible operator (eg, $tetO$ or $lacO$) fused to a promoter sequence. The corresponding repressor is encoded by a nucleic acid in the production strain (eg, a chromosomally-integrated sequence or a sequence comprised by an episome) and the repressor is expressed during the DNA or vector amplification method of the invention, whereby the promoter controlling Cas expression is repressed. In delivery vehicles that are subsequently produced from isolated amplified DNA/vector, the vehicle is devoid of an expressible nucleotide sequence encoding the repressor, whereby the promoter is functional when the DNA/vector is introduced into a target host cell. For example, in the absence of the repressor the promoter is constitutively ON for expression of the Cas. The system is therefore primed to work once the DNA/vector is introduced into the host cells, and this effect can be enhanced further by using a high copy number DNA/vector comprising an origin of replication that is operable in the host cell. A high copy number vector or DNA is also desirable in the production strain cells for enhancing yield of the DNA/vector, and by use of an attenuated promoter as described herein (eg, medium strength promoter and/or repressed promoter in the production strain cells) one can minimise Cas toxicity whilst culturing to maximise amplification and thus yield of the DNA/vector.

17. The method or use of any preceding paragraph, wherein the promoter is a medium strength promoter.

18. The method or use of any preceding paragraph, wherein the promoter has an Anderson Score (AS) of $0.5 > AS > 0.1$.
19. The method or use of any preceding paragraph, wherein the nucleotide sequence encoding said Cas is under the control of a promoter and translation initiation site (TIS) combination that is capable of producing expression of green fluorescent protein (GFP) from a first expression operating unit (EOU) in *E. coli* strain BW25113 cells with a fluorescence of from 0.5 to 4 times the fluorescence produced in *E. coli* strain BW25113 cells using a second EOU comprising a P10 promoter (SEQ ID NO: 1) combined with a BCD14 TIS (SEQ ID NO: 2), wherein the EOUs differ only in their promoter and TIS combinations, wherein each EOU comprises (in 5' to 3' direction) an upstream initiator, the respective promoter, the respective TIS, a nucleotide sequence encoding GFP, a 3' UTR, a transcription terminator and a downstream insulator.
20. The method or use of paragraph 19, wherein fluorescence using the first EOU is 0.5 to 2 times the fluorescence using the second EOU.
21. The method or use of any preceding paragraph, wherein the nuclease is Cas3 and optionally the DNA or cell encodes cognate Cascade proteins.
22. The method or use of any one of paragraphs 1 to 20, wherein the Cas is a Cas9.
23. The method or use of any preceding paragraph, wherein the production strain cells comprise a helper phage genome that is inducible to produce phage coat proteins in the cells, wherein the method further comprises inducing production of the phage proteins and causing packaging of the amplified DNA into phage particles or non-self-replicative transduction particles, and further isolating the phage or transduction particles and optionally formulating the particles into a pharmaceutical composition for administration to a human or animal subject for treating or reducing the risk of a disease or condition in the subject.
24. The method or use of paragraph 23, wherein the particles are capable of infecting target host cells in the subject and transducing the cells with the DNA, wherein the Cas and crRNAs (or guide RNAs, gRNAs) encoded by the DNA are expressed in the cells, the crRNAs or (gRNAs) being operable to guide the Cas to a target nucleotide sequence (optionally a chromosomal sequence) comprised by the cells, wherein the Cas cuts the target sequences in the cells, thereby killing host cells and treating or reducing the risk of the disease or condition.

25. The method or use of paragraph 24, wherein the host cells are bacterial or archaeal cells, optionally, the host cells are *C difficile*, *P aeruginosa*, *K pneumoniae* (eg, carbapenem-resistant *Klebsiella pneumoniae* or Extended-Spectrum Beta-Lactamase (ESBL)-producing *K pneumoniae*), *E coli* (eg, ESBL-producing *E. coli*, or *E. coli* ST131-O25b:H4), *H pylori*, *S pneumoniae* or *S aureus* cells.
26. The method or use of any preceding paragraph, wherein each DNA is comprised by a high copy number plasmid or phagemid.
27. The method or use of any preceding paragraph, wherein the DNA construct comprises one or more nucleotide sequences for producing crRNAs or gRNAs that are operable for Cas nuclease targeting in target host cells.

[00022] PARAGRAPHS & GENERALLY APPLICABLE FEATURES:

The invention provides the following Paragraphs, which are supported by the Examples below. Any features of the Concepts are combinable with any features of the Embodiments. Any features of the Concepts are combinable with any features of the Embodiments. Any features of the Paragraphs are combinable with any features of the Embodiments.

Any cell herein (eg, a production strain cell or target host cell) may be a bacterial cell, archaeal cell, algal cell, fungal cell, protozoan cell, invertebrate cell, vertebrate cell, fish cell, bird cell, mammal cell, companion animal cell, dog cell, cat cell, horse cell, mouse cell, rat cell, rabbit cell, eukaryotic cell, prokaryotic cell, human cell, animal cell, rodent cell, insect cell or plant cell. Preferably, the cell is a bacterial cell. Alternatively, the cell is a human cell. Optionally, the production strain cell(s) and target host cell(s) are of the same phylum, order, family, genus, species or strain.

In an example, the Cas is any Cas (eg, a Cas2, 3, 4, 5, or 6) of a Type I system. In this example, in an embodiment, the Cas may be fused or conjugated to a moiety that is operable to increase or reduce transcription of a gene comprising the target sequence. For example the nucleic acid encoding the Cas may comprise a nucleotide sequence encoding the moiety, wherein the Cas and moiety are expressed in the host cell as a fusion protein. In one embodiment, the Cas is N-terminal of the moiety; in another embodiment it is C-terminal to the moiety.

1. A nucleic acid vector for introduction into a host cell, the vector comprising a first nucleotide sequence encoding a Type I Cas3, wherein the sequence is under the control of a promoter comprised by the vector for expression of the Cas3 in the cell.

In an example, the vector is a DNA vector, eg, ssDNA vector or dsDNA vector.

2. The vector of paragraph 1, wherein the vector comprises a second nucleotide sequence encoding one or more Cascade proteins, wherein the first and second sequences are under the control of one or more promoters comprised by the vector for expression of the proteins in the cell.
3. The vector of paragraph 2, wherein the Cascade protein(s) are cognate with the Cas3.

In an example, the Cas3 is cognate with Cascade proteins encoded by the host cell and/or encoded by a second operon. Optionally, the second operon is comprised by the vector. Optionally, the second operon is comprised by a second vector that is capable of introducing the second operon into the host cell, whereby the Cas3 and Cascade proteins are expressed from the operons in the host cell and are operable with crRNA or gRNA to target the Cas to a host cell target sequence, wherein the Cas3 is capable of modifying the target sequence.

4. The vector of paragraph 2 or 3, wherein the vector comprises an operon for expression in the cell of the Cas3 and Cascade proteins from a Cas module, the module comprising the nucleotide sequences encoding the Cas3 and Cascade proteins, and the operon comprising the Cas module under the control of a promoter for controlling the expression of both the Cas3 and Cascade proteins.

The term “operon” is known to the skilled person such as relating to a functioning unit of DNA containing at least expressible 2 nucleotide sequences respectively encoding for an expression product (eg, a respective translatable mRNA), wherein the sequences are under common promoter control.

5. The vector of paragraph 4, wherein the first sequence is between the promoter and the second sequence in the operon.
6. The vector of paragraph 4 or 5, wherein the operon comprises no Cas-encoding nucleotide sequences between the promoter and the first nucleotide sequence.

Optionally, the Cas3 is a Cas3 encoded by a CRISPR/Cas locus of a first bacterial or archaeal species, wherein in the locus the Cas3-encoding sequence is 3' of Cascade protein-encoding sequences (ie, the latter are between the Cas3 and the 5'-most promoter of the locus).

Optionally, the Cas3 is a ygcB protein (eg, wherein the production strain cell and/or host target cell is an *E coli*).

Optionally, the Cascade proteins comprise or consist of

cas5 (casD, csy2)

cas6 (cas6f, cse3, casE)

cas7 (csc2, csy3, cse4, casC)

cas8 (casA, cas8a1, cas8b1, cas8c, cas10d, cas8e, cse1, cas8f, csy1).

Optionally herein the promoter and the Cas3-encoding sequence are spaced no more than 150, 100, 50, 40, 30, 20 or 10bp apart, eg, from 30-45, or 30-40, or 39 or around 39bp apart.

Optionally herein a ribosome binding site and the Cas3-encoding sequence are spaced no more than 20, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 4 or 3bp apart, eg, from 10-5, 6 or around 6bp apart.

7. The vector of any one of paragraphs 4 to 6, wherein the operon comprises (in 5' to 3' direction) the promoter, the first sequence and the second sequence.
8. The vector of any preceding paragraph, wherein each promoter is a constitutive promoter.
9. The vector of any one of paragraphs 1 to 7, wherein the promoter is repressible (optionally repressible by a tetracycline repressor or lac repressor).
10. The vector of any one of paragraphs 1 to 7, wherein the promoter is inducible.
11. The vector of any preceding paragraph, wherein the first sequence is under the control of a weak promoter.
12. The vector of any one of paragraphs 1 to 7, wherein the first sequence is under the control of a medium strength promoter.
13. The vector of any one of paragraphs 1 to 7, wherein the first sequence is under the control of a strong promoter.

In an example, the promoter is in combination with a Shine-Dalgarno sequence comprising the sequence 5'-aaagaggagaaa-3' (SEQ ID NO: 5) or a ribosome binding site homologue thereof.

14. The vector of any one of paragraphs 1 to 7, wherein the first sequence is under the control of a promoter that has an Anderson Score (AS) of $AS \geq 0.5$.

See Table 2 for more information on Anderson Scores in relation to promoters.

15. The vector of any one of paragraphs 1 to 7, wherein the first sequence is under the control of a promoter that has an Anderson Score (AS) of $0.5 > AS > 0.1$.
16. The vector of any one of paragraphs 1 to 7, wherein the first sequence is under the control of a promoter that has an Anderson Score (AS) of ≤ 0.1 .
17. The vector of any one of paragraphs 1 to 7, wherein the first sequence (and optionally the second sequence) is under the control of a promoter and translation initiation site (TIS) combination that is capable of producing expression of green fluorescent protein (GFP) from a first expression operating unit (EOU) in *E. coli* strain BW25113 cells with a fluorescence of from 0.5 to 4 times the fluorescence produced in *E. coli* strain BW25113 cells using a second EOU comprising a P10 promoter (SEQ ID NO: 1) combined with a BCD14 TIS (SEQ ID NO: 2), wherein the EOUs differ only in their promoter and TIS combinations, wherein each EOU comprises (in 5' to 3' direction) an upstream initiator, the respective promoter, the respective TIS, a nucleotide sequence encoding GFP, a 3' UTR, a transcription terminator and a downstream insulator.
18. The vector of paragraph 17, wherein fluorescence using the first EOU is 0.5 to 2 times the fluorescence using the second EOU.

For example, fluorescence using the first EOU is 0.5 to X times the fluorescence using the second EOU, wherein X is from 3.0 to 1.0, eg, 3, 2.5, 2, 1.5 or 1, wherein fluorescence is determined using excitation at 481 nm and emission at 507 nm. Optionally, *E. coli* cultures at OD600 of 0.3–0.5 in the exponential growth phase are used.

For example, the upstream insulator, the nucleotide sequence encoding GFP, 3' UTR, transcription terminator and downstream insulator of each EOU are as disclosed in Mutalik *et al* (2013). For example, the upstream insulator, the nucleotide sequence encoding GFP, 3' UTR, transcription terminator and downstream insulator of each EOU are corresponding sequences of SEQ ID NO: 4. For example, the *E. coli* is *E. coli* BW25113 is grown in MOPS EZ Rich Medium (Teknova) supplemented with 50 µg/ml kanamycin (kan) at 37 °C, shaken at 900 r.p.m. For example, each EOUs is comprised by a medium copy plasmid, eg, a plasmid derived from pFAB217 comprising a p15A replication origin and a kan resistance gene.

19. The vector of any preceding paragraph, wherein the vector comprises an origin of replication that is operable in the host cell.
20. The vector of any preceding paragraph, wherein the vector comprises an origin of replication that is operable in a bacterial cell of a vector production strain, wherein the Cas3 is not operable in the production strain cell to target and cut a chromosomal sequence thereof.

An example of a production strain cell is an *E coli* cell. A production strain cell is a cell that is used to amplify DNA encoding Cas (and optionally other components of a CRISPR/Cas system). Usefully, the strain may package the amplified DNA into transduction particles that are may be isolated to produce a composition that can be contacted with a population of target host cells (eg, bacterial, archaeal, prokaryotic, eukaryotic, human, animal, mammal, rodent, mouse, rat, rabbit, *Xenopus*, fish, bird, amphibian, insect, plant, amoeba or algae cells) wherein the DNA is introduced into the cells for expression of the Cas (and optional other CRISPR/Cas system components), wherein the Cas is guided to a protospacer target sequence in the host cells and modifies (eg, cuts) the sequence. In another example, the amplified DNA isolated from a population of production strain cells and is combined with a delivery vehicle (eg, a carrier bacterium, nanoparticle or liposome), wherein the delivery vehicle can be contacted with a population of target host cells (eg, bacterial, archaeal, prokaryotic, eukaryotic, human, animal, mammal, rodent, mouse, rat, rabbit, *Xenopus*, fish, bird, amphibian, insect, plant, amoeba or algae cells) wherein the DNA is introduced into the cells for expression of the Cas (and optional other CRISPR/Cas system components), wherein the Cas is guided to a protospacer target sequence in the host cells and modifies (eg, cuts) the sequence.

21. The vector of paragraph 20, wherein the first sequence is under the control of a promoter that is capable of controlling expression of the Cas3 at a level that is not toxic to the production strain cell.

In an example, substantially no production strain cells are killed when the Cas3-encoding sequence is amplified therein. In another example, no more than 40, 30, 20, 10, 5, 4, 3, 2, or 1% of production strain cells are killed when the Cas3-encoding sequence is amplified therein. For example this is in a 1, 2, 3, 4, 5, 6, 7, 8 9 10, 12 or 24 hour period of culturing the cells.

22. The vector of paragraph 20, wherein the first sequence is under the control of a promoter that controls expression of the Cas3 in the production strain cell such that the cell is capable of growth and propagation sufficient to produce at least 1000 copies of the vector.

For example this is in a 1, 2, 3, 4, 5, 6, 7, 8 9 10, 12 or 24 hour period of culturing the cells. For example, at least 10^4 , 10^5 , 10^6 , 10^7 , 10^8 , 10^9 , 10^{10} , 10^{11} , 10^{12} , 10^{13} , 10^{14} , 10^{15} , 10^{16} , 10^{17} or 10^{18} copies of the vector are produced per 10^3 , 10^4 , 10^5 , 10^6 , 10^7 , 10^8 , 10^9 , 10^{10} , 10^{11} , 10^{12} , 10^{13} , 10^{14} , 10^{15} , 10^{16} , 10^{17} production strain cells respectively.

23. The vector of any one of paragraphs 20 to 22, wherein the cell is capable of at least 2 or 3 logs of expansion when the vector is comprised therein.

For example, this is in a 1, 2, 3, 4, 5, 6, 7, 8 9 10, 12 or 24 hour period of culturing the cells.

24. The vector of any preceding paragraph, wherein the vector is a high copy number vector.

25. The vector of any preceding paragraph, wherein the first nucleotide sequence or operon is comprised by a mobile genetic element.

Suitable mobile genetic elements, eg, transposons, are disclosed in WO2016177682 and US20170246221, the disclosures of which are explicitly incorporated herein for possible use in the invention and for providing one or more features for the claims herein.

26. The vector of any preceding paragraph, wherein the vector is devoid of a Cas adaption module.

For example, the vector is devoid of nucleotide sequences encoding a Cas1, Cas2 and/or Cas4.

27. The vector of any preceding paragraph, wherein the vector is devoid of nucleotide sequence encoding one, more or all of a Cas1, Cas2, Cas4, Cas6 (optionally Cas6f), Cas7 and Cas 8 (optionally Cas8f).

28. The vector of any preceding paragraph, wherein the vector is devoid of a sequence encoding a Cas6 (optionally a Cas6f).

29. The vector of any one of paragraphs 1 to 27, wherein the module encodes a Cas6 (optionally a Cas6f).

30. The vector of any preceding paragraph, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas11, Cas7 and Cas8a1.

31. The vector of paragraph 30, wherein the vector comprises nucleotide sequence encoding Cas3' and/or Cas3'' (optionally wherein the nucleotide sequences encoding the Cas3' and/or Cas3'' are between the promoter and the sequence(s) recited in paragraph 30).

In one embodiment, the vector comprises nucleotide sequences (in 5' to 3' direction) that encode a Cas3 (eg, Cas3' and/or Cas3''), Cas11, Cas7 and Cas8a1. Optionally, a nucleotide sequence encoding Cas6 is between the Cas3 sequence(s) and the Cas11 sequence. Optionally, the vector comprises a Type IA CRISPR array or one or more nucleotide sequences encoding single guide RNA(s) (gRNA(s)), wherein the array and each gRNA comprises repeat sequence that is cognate with the Cas3. Thus, the array is operable in a host cell when the vector has been introduced into the cell for production of guide RNAs, wherein the guide RNAs are operable with the Cas and Cascade proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell. Similarly, the single guide RNAs encoded by the vector in one embodiment are operable with the Cas and Cascade proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell.

32. The vector of paragraph 30 or 31, wherein the host cell comprises a Type IA CRISPR array that is cognate with the Cas3.
33. The vector of paragraph 30 or 31, wherein the host cell comprises an endogenous Type IB, C, U, D, E or F CRISPR/Cas system.
34. The vector of any one of paragraphs 1 to 29, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8b1, Cas7 and Cas5.
35. The vector of paragraph 34, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in paragraph 34.

In one embodiment, the vector comprises nucleotide sequences (in 5' to 3' direction) that encode a Cas3, Cas8b1, Cas7 and Cas5. Optionally, a nucleotide sequence encoding Cas6 is between the Cas3 sequence(s) and the Cas8b1 sequence. Optionally, the vector comprises a Type IB CRISPR array or one or more nucleotide sequences encoding single guide RNA(s) (gRNA(s)), wherein the array and each gRNA comprises repeat sequence that is cognate with the Cas3. Thus, the array is operable in a host cell when the vector has been introduced into the cell for production of guide RNAs, wherein the guide RNAs are operable with the Cas and Cascade proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell. Similarly, the single guide RNAs encoded by the vector in one embodiment are operable with the Cas and Cascade

proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell.

36. The vector of paragraph 34 or 35, wherein the host cell comprises a Type IB CRISPR array that is cognate with the Cas3.
37. The vector of paragraph 34 or 35, wherein the host cell comprises an endogenous Type IA, C, U, D, E or F CRISPR/Cas system.
38. The vector of any one of paragraphs 1 to 29, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas5, Cas8c and Cas7.
39. The vector of paragraph 38, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in paragraph 38.

In one embodiment, the vector comprises nucleotide sequences (in 5' to 3' direction) that encode a Cas3, Cas5, Cas8c and Cas7. Optionally, a nucleotide sequence encoding Cas6 is between the Cas3 sequence(s) and the Cas5 sequence. Optionally, the vector comprises a Type IC CRISPR array or one or more nucleotide sequences encoding single guide RNA(s) (gRNA(s)), wherein the array and each gRNA comprises repeat sequence that is cognate with the Cas3. Thus, the array is operable in a host cell when the vector has been introduced into the cell for production of guide RNAs, wherein the guide RNAs are operable with the Cas and Cascade proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell. Similarly, the single guide RNAs encoded by the vector in one embodiment are operable with the Cas and Cascade proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell.

40. The vector of paragraph 38 or 39, wherein the host cell comprises a Type IC CRISPR array that is cognate with the Cas3.
41. The vector of paragraph 38 or 39, wherein the host cell comprises an endogenous Type IA, B, U, D, E or F CRISPR/Cas system.
42. The vector of any one of paragraphs 1 to 29, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8U2, Cas7, Cas5 and Cas6.

43. The vector of paragraph 42, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in paragraph 42.

In one embodiment, the vector comprises nucleotide sequences (in 5' to 3' direction) that encode a Cas3, Cas8U2, Cas7, Cas5 and Cas6. Optionally, a nucleotide sequence encoding Cas6 is between the Cas3 sequence(s) and the Cas8U2 sequence. Optionally, the vector comprises a Type IU CRISPR array or one or more nucleotide sequences encoding single guide RNA(s) (gRNA(s)), wherein the array and each gRNA comprises repeat sequence that is cognate with the Cas3. Thus, the array is operable in a host cell when the vector has been introduced into the cell for production of guide RNAs, wherein the guide RNAs are operable with the Cas and Cascade proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell. Similarly, the single guide RNAs encoded by the vector in one embodiment are operable with the Cas and Cascade proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell.

44. The vector of paragraph 42 or 43, wherein the host cell comprises a Type IU CRISPR array that is cognate with the Cas3.
45. The vector of paragraph 42 or 43, wherein the host cell comprises an endogenous Type IA, B, C, D, E or F CRISPR/Cas system.
46. The vector of any one of paragraphs 1 to 29, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas10d, Cas7 and Cas5.
47. The vector of paragraph 46, wherein the vector comprises a nucleotide sequence encoding Cas3' and/or Cas3'' (optionally wherein the nucleotide sequences encoding the Cas3' and/or Cas3'' are between the promoter and the sequence(s) recited in paragraph 46).

In one embodiment, the vector comprises nucleotide sequences (in 5' to 3' direction) that encode a Cas3, Cas10d, Cas7 and Cas5. Optionally, a nucleotide sequence encoding Cas6 is between the Cas3 sequence(s) and the Cas10d sequence. Optionally, the vector comprises a Type ID CRISPR array or one or more nucleotide sequences encoding single guide RNA(s) (gRNA(s)), wherein the array and each gRNA comprises repeat sequence that is cognate with the Cas3. Thus, the array is operable in a host cell when the vector has been introduced into the cell for production of guide RNAs, wherein the guide RNAs are operable with the Cas and Cascade proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell. Similarly, the single guide RNAs encoded by the vector in one embodiment are operable with the Cas and Cascade

proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell.

48. The vector of paragraph 46 or 47, wherein the host cell comprises a Type ID CRISPR array that is cognate with the Cas3.
49. The vector of paragraph 46 or 47, wherein the host cell comprises an endogenous Type IA, B, C, U, E or F CRISPR/Cas system.
50. The vector of any one of paragraphs 1 to 29, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8e, Cas11, Cas7, Cas5 and Cas6.
51. The vector of paragraph 50, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in paragraph 50.

In one embodiment, the vector comprises nucleotide sequences (in 5' to 3' direction) that encode a Cas3, Cas8e, Cas11, Cas7, Cas5 and Cas6. Optionally, a nucleotide sequence encoding Cas6 is between the Cas3 sequence(s) and the Cas11 sequence. Optionally, the vector comprises a Type IE CRISPR array or one or more nucleotide sequences encoding single guide RNA(s) (gRNA(s)), wherein the array and each gRNA comprises repeat sequence that is cognate with the Cas3. Thus, the array is operable in a host cell when the vector has been introduced into the cell for production of guide RNAs, wherein the guide RNAs are operable with the Cas and Cascade proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell. Similarly, the single guide RNAs encoded by the vector in one embodiment are operable with the Cas and Cascade proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell.

52. The vector of paragraph 50 or 51, wherein the host cell comprises a Type IE CRISPR array that is cognate with the Cas3.
53. The vector of paragraph 50 or 51, wherein the host cell comprises an endogenous Type IA, B, C, D, U or F CRISPR/Cas system.
54. The vector of any one of paragraphs 1 to 29, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8f, Cas5, Cas7 and Cas6f.

55. The vector of paragraph 54, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in paragraph 54, wherein the vector is devoid of nucleotide sequence encoding further Cas between the promoter and the sequence encoding the Cas3.

In one embodiment, the vector comprises nucleotide sequences (in 5' to 3' direction) that encode a Cas3, Cas8f, Cas5, Cas7 and Cas6f. Optionally, a nucleotide sequence encoding Cas6 is between the Cas3 sequence(s) and the Cas8f sequence. Optionally, the vector comprises a Type IF CRISPR array or one or more nucleotide sequences encoding single guide RNA(s) (gRNA(s)), wherein the array and each gRNA comprises repeat sequence that is cognate with the Cas3. Thus, the array is operable in a host cell when the vector has been introduced into the cell for production of guide RNAs, wherein the guide RNAs are operable with the Cas and Cascade proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell. Similarly, the single guide RNAs encoded by the vector in one embodiment are operable with the Cas and Cascade proteins to target and modify (eg, cut) a target nucleotide sequence in the host cell, optionally thereby killing the host cell.

56. The vector of paragraph 54 or 55, wherein the host cell comprises a Type IF CRISPR array that is cognate with the Cas3.
57. The vector of paragraph 54 or 55, wherein the host cell comprises an endogenous Type IA, B, C, D, U or E CRISPR/Cas system.
58. The vector of any one of paragraphs 1 to 29, wherein the Cas and Cascade are Type IA Cas and Cascade proteins.
59. The vector of any one of paragraphs 1 to 29, wherein the Cas and Cascade are Type IB Cas and Cascade proteins.
60. The vector of any one of paragraphs 1 to 29, wherein the Cas and Cascade are Type IC Cas and Cascade proteins.
61. The vector of any one of paragraphs 1 to 29, wherein the Cas and Cascade are Type ID Cas and Cascade proteins.

62. The vector of any one of paragraphs 1 to 29, wherein the Cas and Cascade are Type IE Cas and Cascade proteins.
63. The vector of any one of paragraphs 1 to 29, wherein the Cas and Cascade are Type IF Cas and Cascade proteins.
64. The vector of any one of paragraphs 1 to 29, wherein the Cas and Cascade are Type IU Cas and Cascade proteins.
65. The vector of any one of paragraphs 1 to 29, wherein the Cas and Cascade are *E coli* (optionally Type IE or IF) Cas and Cascade proteins, optionally wherein the *E coli* is ESBL-producing *E. coli* or *E. coli* ST131-O25b:H4.
66. The vector of any one of paragraphs 1 to 29, wherein the Cas and Cascade are *Clostridium* (eg, *C difficile*) Cas and Cascade proteins, optionally *C difficile* resistant to one or more antibiotics selected from aminoglycosides, lincomycin, tetracyclines, erythromycin, clindamycin, penicillins, cephalosporins and fluoroquinolones.
67. The vector of any one of paragraphs 1 to 29, wherein the Cas and Cascade are *Pseudomonas aeruginosa* Cas and Cascade proteins, optionally *P aeruginosa* resistant to one or more antibiotics selected from carbapenems, aminoglycosides, cefepime, ceftazidime, fluoroquinolones, piperacillin and tazobactam.
68. The vector of any one of paragraphs 1 to 29, wherein the Cas and Cascade are *Klebsiella pneumoniae* (eg, carbapenem-resistant *Klebsiella pneumoniae* or Extended-Spectrum Beta-Lactamase (ESBL)-producing *K pneumoniae*) Cas and Cascade proteins.
69. The vector of any one of paragraphs 1 to 29, wherein the Cas and Cascade are *E coli*, *C difficile*, *P aeruginosa*, *K pneumoniae*, *P furiosus* or *B halodurans* Cas and Cascade proteins.
70. The vector of any preceding paragraph, wherein the Cas3 is a Cas3 of a CRISPR/Cas locus of a first bacterial or archaeal species, wherein the distance between the Cas3-encoding sequence of the locus and its cognate promoter is further than the distance between the Cas3-encoding sequence and the respective promoter comprised by the vector.

The cognate promoter here is the one that controls expression of Cas3 in the wild-type locus.

71. The vector of any preceding paragraph, wherein the distance between the promoter and the Cas3-encoding sequence and/or Cascade protein-encoding sequence(s) is shorter than in a corresponding wild-type Type I locus.

A corresponding locus is a wild-type locus of a bacterial or archaeal species or strain that comprises an endogenous CRISPR/Cas system encoding the Cas3 and/or Cascade proteins of the type that are also encoded by the vector. Thus, when the vector comprises an operon, the operon may comprise Cas3- and Cascade-encoding nucleotide sequences that are not in a natural configuration.

72. The vector of any preceding paragraph, wherein the vector comprises (i) a CRISPR array for producing crRNAs in the host cell and/or (ii) one or more nucleotide sequences encoding one or more single guide RNAs (gRNAs), wherein the crRNAs or gRNAs are cognate to the Cas3 (and optionally cognate to the Cascade proteins).
73. The vector of paragraph 72 when dependent from paragraph 4, wherein the array or gRNA-encoding sequence(s) are comprised by the operon and under the control of the promoter.
74. The vector of paragraph 72, wherein the array or gRNA-encoding sequence(s) are under the control of a promoter that is different from the promoter that controls the expression of the Cas3.
75. The vector of any one of paragraphs 72 to 74, wherein one or more of the crRNAs or gRNAs comprises a spacer sequence that is capable of hybridising to a target nucleotide sequence of the host cell, wherein the target sequence is adjacent a PAM, the PAM being cognate to the Cas3.
- Thus, the spacer hybridises to the protospacer to guide the Cas3 to the protospacer. Optionally, the Cas3 cuts the protospacer, eg, using exo- and/or endonuclease activity of the Cas3. Optionally, the Cas3 removes a plurality (eg, at least 2, 3, 4, 5, 6, 7, 8, 9 or 10) nucleotides from the protospacer.
76. The vector of paragraph 75, wherein the target sequence is a chromosomal sequence of the host cell.
77. The vector of paragraph 75 or 76, wherein the Cas3 is operable to cut the target sequence.
78. The vector of any preceding paragraph, wherein the vector is a plasmid or phagemid.

79. A delivery vehicle comprising the vector of any preceding paragraph, wherein the delivery vehicle is capable of delivering the vector into the host cell.
80. The vehicle of paragraph 79, wherein the delivery vehicle is a phage, non-replicative transduction particle, nanoparticle carrier, bacterium or liposome.

The phage or particles comprise phage coat proteins encapsidating DNA, wherein the DNA comprises the vector. Suitable examples of phage and particles are disclosed in USSN 15/985,658 (and its equivalent publication by USPTO) the disclosures of which are incorporated herein by reference for possible use in the invention and for providing one or more features that may be included in the claims herein. Phage or particle is capable of infecting the cell, thereby introducing the vector into the cell.

81. The vector or vehicle of any preceding paragraph, wherein the host cell is a bacterial or archaeal cell, optionally, the host cell is a *C difficile*, *P aeruginosa*, *K pneumoniae* (eg, carbapenem-resistant *Klebsiella pneumoniae* or Extended-Spectrum Beta-Lactamase (ESBL)-producing *K pneumoniae*), *E coli* (eg, ESBL-producing *E. coli*, or *E. coli* ST131-O25b:H4), *H pylori*, *S pneumoniae* or *S aureus* cell.
82. The vector or vehicle of any preceding paragraph for administration to a human or animal subject for treating or reducing the risk of a disease or condition in the subject.
83. The vector or vehicle of paragraph 82, wherein the disease or condition is an infection of the subject with host cells (eg, bacterial cells), or wherein the disease or condition is mediated by host cells (eg, bacterial cells).
84. A pharmaceutical composition comprising the vector or vehicle of any preceding paragraph and a pharmaceutically acceptable diluent, excipient or carrier.
85. A method of amplifying copies of a DNA encoding a functional Cas protein (optionally a Cas nuclease) in a bacterial or archaeal production strain of cells, the method comprising
- (a) Providing production strain cells, each cell comprising a copy of said DNA, wherein each DNA comprises a nucleotide sequence encoding said Cas, wherein the nucleotide sequence is under the control of a promoter for controlling the expression of the Cas in the production strain cell, the DNA comprising an origin of replication that is operable in the cell for replication of the DNA;
 - (b) Culturing the cells to allow replication of the DNA, whereby the DNA is amplified; and

(c) Optionally isolating copies of the DNA,

86. The method of paragraph 85, wherein the promoter is a constitutive promoter.
87. The method of paragraph 85, wherein the promoter is repressible (optionally repressible by a tetracycline repressor or a lac repressor).
88. The method of paragraph 85, wherein the promoter is inducible.
89. The method of any one of paragraphs 85 to 88, wherein the promoter is a medium strength promoter.
90. The method of any one of paragraphs 85 to 89, wherein the promoter has an Anderson Score (AS) of $0.5 > AS > 0.1$.
91. The method of any one of paragraphs 85 to 90, wherein the nucleotide sequence encoding said Cas is under the control of a promoter and translation initiation site (TIS) combination that is capable of producing expression of green fluorescent protein (GFP) from a first expression operating unit (EOU) in *E. coli* strain BW25113 cells with a fluorescence of from 0.5 to 4 times the fluorescence produced in *E. coli* strain BW25113 cells using a second EOU comprising a P10 promoter (SEQ ID NO: 1) combined with a BCD14 TIS (SEQ ID NO: 2), wherein the EOUs differ only in their promoter and TIS combinations, wherein each EOU comprises (in 5' to 3' direction) an upstream initiator, the respective promoter, the respective TIS, a nucleotide sequence encoding GFP, a 3' UTR, a transcription terminator and a downstream insulator.
92. The method of paragraph 91, wherein fluorescence using the first EOU is 0.5 to 2 times the fluorescence using the second EOU.
93. The method of any one of paragraphs 85 to 92, wherein the nuclease is Cas3 and optionally the DNA or cell encodes cognate Cascade proteins and/or one or more crRNAs that are operable for Cas nuclease targeting.

For example, the targeting is targeting of the Cas to a protospacer sequence comprised by a host cell chromosome or an episome thereof. In another example the targeting is in a recombineering method and the Cas is targeted to a protospacer sequence of a DNA that has been introduced into or amplified in the host cell. In an example of such recombineering, the host cell is an *E. coli* cell.

94. The method of any one of paragraphs 85 to 92, wherein the Cas is a Cas9.
95. The method of any one of paragraphs 85 to 92, wherein the Cas is a Type IIIA csm protein or a Type IIIB cmr protein.
96. The method of any one of paragraphs 85 to 92, wherein the Cas is a Csf1.
97. The method of any one of paragraphs 85 to 92, wherein the Cas is a Cpf1.
98. The method of any one of paragraphs 85 to 92, wherein the Cas is a Cas13 (optionally Cas13a or Cas13b).
99. The method of any one of paragraphs 85 to 92, wherein the Cas is selected from a Cas3, Cas8a, Cas5, Cas8b, Cas8c, Cas10d, Cse1, Cse2, Csy1, Csy2, Csy3, GSU0054, Cas10, Csm2, Cmr5, Cas10, Csx11, Csx10, Csf1, Cas9, Csn2, Cas4, Cpf1, C2c1, C2c3, Cas13a, Cas13b and Cas13c.
100. The method of any one of paragraphs 85 to 99, wherein the production strain cells comprise a helper phage genome that is inducible to produce phage coat proteins in the cells, wherein the method further comprises inducing production of the phage proteins and causing packaging of the amplified DNA into phage particles or non-self-replicative transduction particles, and further isolating the phage or transduction particles and optionally formulating the particles into a pharmaceutical composition for administration to a human or animal subject for treating or reducing the risk of a disease or condition in the subject.
101. The method of paragraph 100, wherein the particles are capable of infecting target host cells in the subject and transducing the cells with the DNA, wherein the Cas and crRNAs (or gRNAs) encoded by the DNA are expressed in the cells, the crRNAs or (gRNAs) being operable to guide the Cas to a target nucleotide sequence (optionally a chromosomal sequence) comprised by the cells, wherein the Cas cuts the target sequences in the cells, thereby killing host cells and treating or reducing the risk of the disease or condition.
102. The method of paragraph 101, wherein the host cells are bacterial or archaeal cells, optionally, the host cells are *C difficile*, *P aeruginosa*, *K pneumoniae* (eg, carbapenem-resistant *Klebsiella pneumoniae* or Extended-Spectrum Beta-Lactamase (ESBL)-producing *K pneumoniae*), *E coli* (eg, ESBL-producing *E. coli*, or *E. coli* ST131-O25b:H4), *H pylori*, *S pneumoniae* or *S aureus* cells.

103. The method of any one of paragraphs 85 to 102, wherein each DNA is comprised by a high copy number vector, optionally a high copy number plasmid (an optionally the promoter is a constitutive promoter).
104. The method of any one of paragraphs 85 to 103, wherein each DNA is comprised by a vector or vehicle according to any one of paragraphs 1 to 83.
105. Use of an attenuated strength promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for enhancing the yield of amplified DNA produced by the production host cells.

Thus, said enhancing may be relative to the yield produced using a strong promoter, eg, a strong constitutive promoter (for example a promoter having an Anderson Score (AS) of $AS \geq 0.5$). In another example, the strong promoter is a promoter comprised by a promoter and translation initiation site (TIS) combination that is capable of producing expression of green fluorescent protein (GFP) from a first expression operating unit (EOU) in *E. coli* strain BW25113 cells with a fluorescence of >4 times the fluorescence produced in *E. coli* strain BW25113 cells using a second EOU comprising a P10 promoter (SEQ ID NO: 1) combined with a BCD14 TIS (SEQ ID NO: 2), wherein the EOUs differ only in their promoter and TIS combinations, wherein each EOU comprises (in 5' to 3' direction) an upstream initiator, the respective promoter, the respective TIS, a nucleotide sequence encoding GFP, a 3' UTR, a transcription terminator and a downstream insulator.

106. The use of paragraph 105, wherein the use is for enhancing said yield by
- (d) reducing toxicity of the Cas in the production strain;
 - (e) reducing mutation of the DNA (optionally the Cas-encoding sequence) in the production strain;
 - (f) promoting production cell viability during the amplification of the DNA; and/or
 - (g) reducing the occurrence of Cas cutting of DNA (optionally cutting of production host cell chromosomal DNA or said DNA construct).
107. Use of an attenuated strength promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA

thereby amplifying the DNA in the cells, for reducing toxicity of the Cas in the production strain.

108. Use of an attenuated strength promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for reducing mutation of the DNA (optionally the Cas-encoding sequence) in the production strain.
109. Use of an attenuated strength promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for promoting production cell viability during the amplification of the DNA.
110. Use of an attenuated strength promoter in a DNA construct comprising a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of the promoter, in a method of amplifying copies of the DNA in a population of bacterial or archaeal production strain cells, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, for reducing the occurrence of Cas cutting of DNA.
111. A method for enhancing the yield of amplified copies of a DNA construct in a population of bacterial or archaeal production strain cells, wherein the construct comprises a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) that is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated strength promoter.
112. A method for reducing toxicity of a functional Cas protein (optionally a Cas nuclease) in a population of bacterial or archaeal production strain cells in a process of amplifying copies of a DNA construct, wherein the construct comprises a nucleotide sequence encoding the Cas and the sequence is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated strength promoter.
113. A method for reducing mutation of a DNA construct encoding a functional Cas protein (optionally a Cas nuclease) in a population of bacterial or archaeal production strain cells in a

process of amplifying copies of the construct, wherein the construct comprises a nucleotide sequence encoding the Cas and the sequence is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated strength promoter.

114. A method for promoting production cell viability of a population of bacterial or archaeal production strain cells in a process of amplifying copies of a DNA construct comprised by the cells, wherein the construct comprises a nucleotide sequence encoding a functional Cas protein (optionally a Cas nuclease) and the sequence is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated strength promoter.
115. A method for reducing the occurrence of Cas nuclease cutting of a DNA construct in a population of bacterial or archaeal production strain cells in a process of amplifying copies of the construct, wherein the construct comprises a nucleotide sequence encoding the Cas and the sequence is under the control of a promoter, the method comprising culturing the cells to allow replication of the DNA thereby amplifying the DNA in the cells, wherein the promoter is an attenuated strength promoter.
116. The use of paragraph 108 or 110, or the method of paragraph 113 or 115, wherein the mutation or cutting is mutation or cutting of host cell chromosomal DNA or the construct DNA.
117. The use or method of any one of paragraphs 105 to 116, wherein the promoter is a constitutive promoter.
118. The use or method of any one of paragraphs 105 to 117, wherein the promoter is repressible (optionally repressible by a tetracycline repressor or a lac repressor).

In an example, the promoter is a constitutive promoter and optionally the DNA is comprised by a high copy number plasmid or phagemid.

119. The use or method of any one of paragraphs 105 to 118, wherein the promoter is $P_{LtetO-1}$, $P_{LlacO-1}$ or a repressible homologue thereof.

$P_{LlacO-1}$ is repressed by lac repressor (LacR). $P_{LtetO-1}$ is repressed by tet repressor (TetR).

120. The use or method of any one of paragraphs 105 to 119, wherein the promoter is a medium strength promoter.
121. The use or method of any one of paragraphs 105 to 120, wherein the promoter has an Anderson Score (AS) of $0.5 > AS > 0.1$.
122. The use or method of any one of paragraphs 105 to 121, wherein the nucleotide sequence encoding said Cas is under the control of a promoter and translation initiation site (TIS) combination that is capable of producing expression of green fluorescent protein (GFP) from a first expression operating unit (EOU) in *E. coli* strain BW25113 cells with a fluorescence of from 0.5 to 4 times the fluorescence produced in *E. coli* strain BW25113 cells using a second EOU comprising a P10 promoter (SEQ ID NO: 1) combined with a BCD14 TIS (SEQ ID NO: 2), wherein the EOUs differ only in their promoter and TIS combinations, wherein each EOU comprises (in 5' to 3' direction) an upstream initiator, the respective promoter, the respective TIS, a nucleotide sequence encoding GFP, a 3' UTR, a transcription terminator and a downstream insulator.
123. The use or method of paragraph 122, wherein fluorescence using the first EOU is 0.5 to 2 times the fluorescence using the second EOU.
124. The use or method of any one of paragraphs 105 to 123, wherein the nuclease is Cas3 and optionally the DNA construct encodes cognate Cascade proteins.
125. The use or method of any one of paragraphs 105 to 123, wherein the Cas is a Cas9.
126. The use or method of any one of paragraphs 105 to 123, wherein the Cas is a Type IIIA csm protein or a Type IIIB cmr protein.
127. The use or method of any one of paragraphs 105 to 123, wherein the Cas is a Csf1.
128. The use or method of any one of paragraphs 105 to 123, wherein the Cas is a Cpf1.
129. The use or method of any one of paragraphs 105 to 123, wherein the Cas is a Cas13 (optionally Cas13a or Cas13b).
130. The use or method of any one of paragraphs 105 to 123, wherein the Cas is selected from a Cas3, Cas8a, Cas5, Cas8b, Cas8c, Cas10d, Cse1, Cse2, Csy1, Csy2, Csy3, GSU0054, Cas10,

Csm2, Cmr5, Cas10, Csx11, Csx10, Csf1, Cas9, Csn2, Cas4, Cpf1, C2c1, C2c3, Cas13a, Cas13b and Cas13c.

131. The use or method of any one of paragraphs 105 to 130, wherein the DNA construct comprises one or more nucleotide sequences for producing crRNAs or gRNAs that are operable for Cas nuclease targeting.
132. The use or method of any one of paragraphs 105 to 131, wherein the production strain cells comprise a helper phage genome that is inducible to produce phage coat proteins in the cells, wherein the method further comprises inducing production of the phage proteins and causing packaging of the amplified DNA into phage particles or non-self-replicative transduction particles, and further isolating the phage or transduction particles and optionally formulating the particles into a pharmaceutical composition for administration to a human or animal subject for treating or reducing the risk of a disease or condition in the subject.
133. The method of paragraph 132, wherein the particles are capable of infecting target host cells in the subject and transducing the cells with the DNA, wherein the Cas and crRNAs (or gRNAs) encoded by the DNA are expressed in the cells, the crRNAs or (gRNAs) being operable to guide the Cas to a target nucleotide sequence (optionally a chromosomal sequence) comprised by the cells, wherein the Cas cuts the target sequences in the cells, thereby killing host cells and treating or reducing the risk of the disease or condition.
134. The method of paragraph 133, wherein the host cells are bacterial or archaeal cells, optionally, the host cells are *C difficile*, *P aeruginosa*, *K pneumoniae* (eg, carbapenem-resistant *Klebsiella pneumoniae* or Extended-Spectrum Beta-Lactamase (ESBL)-producing *K pneumoniae*), *E coli* (eg, ESBL-producing *E. coli*, or *E. coli* ST131-O25b:H4), *H pylori*, *S pneumoniae* or *S aureus* cells.
135. The use or method of any one of paragraphs 105 to 134, wherein each DNA is comprised by a high copy number vector, optionally a high copy number plasmid (an optionally the promoter is a constitutive promoter).
136. The use or method of any one of paragraphs 105 to 135, wherein each DNA is comprised by a vector according to any one of paragraphs 1 to 78 and 81 to 83.

[00023] There is also provided the following clauses:-

CLAUSES:

1. A nucleic acid vector for introduction into a host cell, the vector comprising a first nucleotide sequence encoding a Type I Cas3 and a second nucleotide sequence encoding one or more Cascade proteins, wherein the first and second sequences are under the control of one or more promoters comprised by the vector for expression of the proteins in the cell.
2. The vector of clause 1, wherein the vector comprises an operon for expression in the cell of the Cas3 and Cascade proteins from a Cas module, the module comprising the nucleotide sequences encoding the Cas3 and Cascade proteins, and the operon comprising the Cas module under the control of a promoter for controlling the expression of both the Cas3 and Cascade proteins.
3. The vector of clause 2, wherein
 - (a) the first sequence is between the promoter and the second sequence in the operon;
 - (b) the operon comprises no Cas-encoding nucleotide sequences between the promoter and the first nucleotide sequence; and/or
 - (c) the operon comprises (in 5' to 3' direction) the promoter, the first sequence and the second sequence.
4. The vector of any preceding clause, wherein each promoter is a constitutive promoter.
5. The vector of any one of clauses 1 to 3, wherein the promoter is repressible (optionally repressible by a tetracycline repressor or lac repressor).
6. The vector of any one of clauses 1 to 3, wherein the promoter is inducible.
7. The vector of any preceding clause, wherein the first sequence is under the control of a medium strength promoter.
8. The vector of any preceding clause, wherein the first sequence is under the control of a promoter that has an Anderson Score (AS) of $0.5 > AS > 0.1$.
9. The vector of any preceding clause, wherein the first sequence (and optionally the second sequence) is under the control of a promoter and translation initiation site (TIS) combination that is capable of producing expression of green fluorescent protein (GFP) from a first expression operating unit (EOU) in *E. coli* strain BW25113 cells with a fluorescence of from 0.5 to 4 times the fluorescence produced in *E. coli* strain BW25113 cells using a second EOU comprising a P10

promoter (SEQ ID NO: 1) combined with a BCD14 TIS (SEQ ID NO: 2), wherein the EOUs differ only in their promoter and TIS combinations, wherein each EOU comprises (in 5' to 3' direction) an upstream initiator, the respective promoter, the respective TIS, a nucleotide sequence encoding GFP, a 3' UTR, a transcription terminator and a downstream insulator.

10. The vector of clause 9, wherein fluorescence using the first EOU is 0.5 to 2 times the fluorescence using the second EOU.
11. The vector of any preceding clause, wherein the vector comprises an origin of replication that is operable in the host cell.
12. The vector of any preceding clause, wherein the vector comprises an origin of replication that is operable in a bacterial cell of a vector production strain, wherein the Cas3 is not operable in the production strain cell to target and cut a chromosomal sequence thereof.
13. The vector of clause 12, wherein the first sequence is under the control of a promoter that is capable of controlling expression of the Cas3 at a level that is not toxic to the production strain cell.
14. The vector of any preceding clause, wherein the vector is a high copy number vector.
15. The vector of any preceding clause, wherein the first nucleotide sequence or operon is comprised by a mobile genetic element.
16. The vector of any preceding clause, wherein the vector is devoid of a Cas adaption module.
17. The vector of any preceding clause, wherein the vector is devoid of nucleotide sequence encoding one, more or all of a Cas1, Cas2, Cas4, Cas6, Cas7 and Cas 8.
18. The vector of any preceding clause, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas11, Cas7 and Cas8a1.
19. The vector of clause 18, wherein the vector comprises nucleotide sequence encoding Cas3' and/or Cas3''.

20. The vector or clause 19, wherein the nucleotide sequences encoding the Cas3' and/or Cas3'' are between the promoter and the sequence(s) recited in clause 18.
21. The vector of any one of clauses 18 to 20, wherein the host cell comprises a Type IA CRISPR array that is cognate with the Cas3.
22. The vector of any one of clauses 18 to 20, wherein the host cell comprises an endogenous Type IB, C, U, D, E or F CRISPR/Cas system.
23. The vector of any one of clauses 1 to 17, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8b1, Cas7 and Cas5.
24. The vector of clause 23, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in clause 23.
25. The vector of clause 23 or 24, wherein the host cell comprises a Type IB CRISPR array that is cognate with the Cas3.
26. The vector of clause 23 or 24, wherein the host cell comprises an endogenous Type IA, C, U, D, E or F CRISPR/Cas system.
27. The vector of any one of clauses 1 to 17, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas5, Cas8c and Cas7.
28. The vector of clause 27, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in clause 27.
29. The vector of clause 27 or 28, wherein the host cell comprises a Type IC CRISPR array that is cognate with the Cas3.
30. The vector of clause 27 or 28, wherein the host cell comprises an endogenous Type IA, B, U, D, E or F CRISPR/Cas system.
31. The vector of any one of clauses 1 to 17, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8U2, Cas7, Cas5 and Cas6.

32. The vector of clause 31, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in clause 31.
33. The vector of clause 31 or 32, wherein the host cell comprises a Type IU CRISPR array that is cognate with the Cas3.
34. The vector of clause 31 or 32, wherein the host cell comprises an endogenous Type IA, B, C, D, E or F CRISPR/Cas system.
35. The vector of any one of clauses 1 to 17, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas10d, Cas7 and Cas5.
36. The vector of clause 35, wherein the vector comprises a nucleotide sequence encoding Cas3' and/or Cas3''.
37. The vector of clause 36, wherein the nucleotide sequences encoding the Cas3' and/or Cas3'' are between the promoter and the sequence(s) recited in clause 35.
38. The vector of any one of clauses 35 to 37, wherein the host cell comprises a Type ID CRISPR array that is cognate with the Cas3.
39. The vector of any one of clauses 35 to 37, wherein the host cell comprises an endogenous Type IA, B, C, U, E or F CRISPR/Cas system.
40. The vector of any one of clauses 1 to 17, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8e, Cas11, Cas7, Cas5 and Cas6.
41. The vector of clause 40, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in clause 40.
42. The vector of clause 40 or 41, wherein the host cell comprises a Type IE CRISPR array that is cognate with the Cas3.
43. The vector of clause 40 or 41, wherein the host cell comprises an endogenous Type IA, B, C, D, U or F CRISPR/Cas system.

44. The vector of any one of clauses 1 to 17, wherein the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8f, Cas5, Cas7 and Cas6f.
45. The vector of clause 44, wherein the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in clause 44, wherein the vector is devoid of nucleotide sequence encoding further Cas between the promoter and the sequence encoding the Cas3.
46. The vector of clause 44 or 45, wherein the host cell comprises a Type IF CRISPR array that is cognate with the Cas3.
47. The vector of clause 44 or 45, wherein the host cell comprises an endogenous Type IA, B, C, D, U or E CRISPR/Cas system.
48. The vector of any one of clauses 1 to 17, wherein the Cas and Cascade are
- (a) Type IA Cas and Cascade proteins;
 - (b) Type IB Cas and Cascade proteins;
 - (c) Type IC Cas and Cascade proteins;
 - (d) Type ID Cas and Cascade proteins;
 - (e) Type IE Cas and Cascade proteins;
 - (f) Type IF Cas and Cascade proteins; or
 - (g) Type IU Cas and Cascade proteins.
49. The vector of any preceding clause, wherein the Cas and Cascade are *E. coli* (optionally Type IE or IF) Cas and Cascade proteins.
50. The vector of clause 49, wherein the *E. coli* is ESBL-producing *E. coli* or *E. coli* ST131-O25b:H4.
51. The vector of any preceding clause, wherein the Cas and Cascade are
- (a) *Clostridium* (eg, *C. difficile*) Cas and Cascade proteins, optionally *C. difficile* resistant to one or more antibiotics selected from aminoglycosides, lincomycin, tetracyclines, erythromycin, clindamycin, penicillins, cephalosporins and fluoroquinolones;
 - (b) *Pseudomonas aeruginosa* Cas and Cascade proteins, optionally *P. aeruginosa* resistant to one or more antibiotics selected from carbapenems, aminoglycosides, cefepime, ceftazidime, fluoroquinolones, piperacillin and tazobactam; or

- (c) *Klebsiella pneumoniae* (eg, carbapenem-resistant *Klebsiella pneumoniae* or Extended-Spectrum Beta-Lactamase (ESBL)-producing *K pneumoniae*) Cas and Cascade proteins.
52. The vector of any preceding clause, wherein the Cas and Cascade are *E coli*, *C difficile*, *P aeruginosa*, *K pneumoniae*, *P furiosus* or *B halodurans* Cas and Cascade proteins.
53. The vector of any preceding clause, wherein the Cas3 is a Cas3 of a CRISPR/Cas locus of a first bacterial or archaeal species, wherein the distance between the Cas3-encoding sequence of the locus and its cognate promoter is further than the distance between the Cas3-encoding sequence and the respective promoter comprised by the vector.
54. The vector of any preceding clause, wherein the distance between the promoter and the Cas3-encoding sequence and/or Cascade protein-encoding sequence(s) is shorter than in a corresponding wild-type Type I locus.
55. The vector of any preceding clause, wherein the vector comprises (i) a CRISPR array for producing crRNAs in the host cell and/or (ii) one or more nucleotide sequences encoding one or more guide RNAs (gRNAs or single gRNAs), wherein the crRNAs or gRNAs are cognate to the Cas3 (and optionally cognate to the Cascade proteins).
56. The vector of clause 55 when dependent from clause 2, wherein the array or gRNA-encoding sequence(s) are comprised by the operon and under the control of the promoter.
57. The vector of clause 56, wherein the array or gRNA-encoding sequence(s) are under the control of a promoter that is different from the promoter that controls the expression of the Cas3.
58. The vector of clause 56 or 57, wherein one or more of the crRNAs or gRNAs comprises a spacer sequence that is capable of hybridising to a target nucleotide sequence of the host cell, wherein the target sequence is adjacent a PAM, the PAM being cognate to the Cas3.
59. The vector of clause 58, wherein the target sequence is a chromosomal sequence of the host cell.
60. The vector of clause 58 or 59, wherein the Cas3 is operable to cut the target sequence.
61. The vector of any preceding clause, wherein the vector is a plasmid or phagemid.

62. A delivery vehicle comprising the vector of any preceding clause, wherein the delivery vehicle is capable of delivering the vector into the host cell.
63. The vehicle of clause 62, wherein the delivery vehicle is a phage, non-replicative transduction particle, nanoparticle carrier, bacterium or liposome.
64. The vector or vehicle of any preceding clause, wherein the host cell is a bacterial or archaeal cell, optionally, the host cell is a *C difficile*, *P aeruginosa*, *K pneumoniae* (eg, carbapenem-resistant *Klebsiella pneumoniae* or Extended-Spectrum Beta-Lactamase (ESBL)-producing *K pneumoniae*), *E coli* (eg, ESBL-producing *E. coli*, or *E. coli* ST131-O25b:H4), *H pylori*, *S pneumoniae* or *S aureus* cell.
65. The vector or vehicle of any preceding clause for administration to a human or animal subject for treating or reducing the risk of a disease or condition in the subject.
66. The vector or vehicle of clause 65, wherein the disease or condition is an infection of the subject with host cells (eg, bacterial cells), or wherein the disease or condition is mediated by host cells (eg, bacterial cells).
67. A pharmaceutical composition comprising the vector or vehicle of any preceding clause and a pharmaceutically acceptable diluent, excipient or carrier.

[00024] It will be understood that particular embodiments described herein are shown by way of illustration and not as limitations of the invention. The principal features of this invention can be employed in various embodiments without departing from the scope of the invention. Those skilled in the art will recognize, or be able to ascertain using no more than routine study, numerous equivalents to the specific procedures described herein. Such equivalents are considered to be within the scope of this invention and are covered by the claims. All publications and patent applications mentioned in the specification are indicative of the level of skill of those skilled in the art to which this invention pertains. All publications and patent applications and all US equivalent patent applications and patents are herein incorporated by reference to the same extent as if each individual publication or patent application was specifically and individually indicated to be incorporated by reference. Reference is made to WO2017/118598, US20180140698, US20170246221, US20180273940, US20160115488, US20180179547, US20170175142, US20160024510, US20150064138, US20170022499, US20160345578, US20180155729, US20180200342, WO2017112620, WO2018081502, PCT/EP2018/066954, PCT/EP2018/066980, PCT/EP2018/071454 and USSN 15/985,658 and equivalent publications by

the US Patent and Trademark Office (USPTO) or WIPO, the disclosures of which are incorporated herein by reference for providing disclosure that may be used in the present invention and/or to provide one or more features (eg, of a vector) that may be included in one or more claims herein.

[00025] The use of the word "a" or "an" when used in conjunction with the term "comprising" in the claims and/or the specification may mean "one," but it is also consistent with the meaning of "one or more," "at least one," and "one or more than one." The use of the term "or" in the claims is used to mean "and/or" unless explicitly indicated to refer to alternatives only or the alternatives are mutually exclusive, although the disclosure supports a definition that refers to only alternatives and "and/or." Throughout this application, the term "about" is used to indicate that a value includes the inherent variation of error for the device, the method being employed to determine the value, or the variation that exists among the study subjects.

[00026] As used in this specification and claim(s), the words "comprising" (and any form of comprising, such as "comprise" and "comprises"), "having" (and any form of having, such as "have" and "has"), "including" (and any form of including, such as "includes" and "include") or "containing" (and any form of containing, such as "contains" and "contain") are inclusive or open-ended and do not exclude additional, unrecited elements or method steps

[00027] The term "or combinations thereof" or similar as used herein refers to all permutations and combinations of the listed items preceding the term. For example, "A, B, C, or combinations thereof" is intended to include at least one of: A, B, C, AB, AC, BC, or ABC, and if order is important in a particular context, also BA, CA, CB, CBA, BCA, ACB, BAC, or CAB. Continuing with this example, expressly included are combinations that contain repeats of one or more item or term, such as BB, AAA, MB, BBC, AAABCCCC, CBBAAA, CABABB, and so forth. The skilled artisan will understand that typically there is no limit on the number of items or terms in any combination, unless otherwise apparent from the context.

[00028] Any part of this disclosure may be read in combination with any other part of the disclosure, unless otherwise apparent from the context.

[00029] All of the compositions and/or methods disclosed and claimed herein can be made and executed without undue experimentation in light of the present disclosure. While the compositions and methods of this invention have been described in terms of preferred embodiments, it will be apparent to those of skill in the art that variations may be applied to the compositions and/or methods and in the steps or in the sequence of steps of the method described herein without departing from the concept, spirit and scope of the invention. All such similar substitutes and modifications apparent to those skilled in the art are deemed to be within the spirit, scope and concept of the invention as defined by the appended claims.

[00030] The present invention is described in more detail in the following non-limiting Examples.

EXAMPLES

[00031] The examples illustrate fast and precision killing of *Escherichia coli* strains. As a model programmable nuclease system, we used a CRISPR guided vector (CGVTM) to specifically target *Escherichia coli* MG1655.

EXAMPLE 1. Single-Vector Cas3 & Cascade: Type I CRISPR-Cas system targeting *E. coli*.

[00032] A plasmid (which we call a CRISPR Guided VectorTM, CGVTM) was constructed comprising an operon with nucleotide sequences encoding a Type I Cas3 and Cascade proteins under the control of a common promoter. *C. difficile* Type IB Cas3 and Cascade was used. A cognate CRISPR array comprising *C. difficile* repeat sequences and spacer sequence for targeting an *E. coli* host cell chromosome was also introduced into target cells. An adaptation module containing Cas1, Cas2 and Cas4 was omitted in the vector (see Fig. 1A). In the wild-type *C. difficile* Type IB CRISPR/Cas locus, the *cas3* gene is 3' of the Cascade genes (*cas8b1*, *cas7* and *cas5*) and thus spaced away from the promoter upstream of the Cascade genes. When we tried this arrangement, we found killing of *E. coli* cells, but surprisingly when we changed to a synthetic operon arrangement (in 5' to 3' orientation) of promoter, *cas3*, *cas8b1*, *cas7* and *cas5* we saw significantly higher killing of the target *E. coli* cells.

[00033] Results using this synthetic operon arrangement are shown in Figure 1. In Fig 1B there is shown a dilution series (10^1 – 10^6) of drop spots (5 μ l) of target *E. coli* MG1655 cells harboring the CGV on LB agar plates with and without inducers. CRISPR/Cas induction surprisingly killed 99.9% of the population (Fig 1C, grey bar). Growth in absence of induction is shown in black. CGVTM refers to a CRISPR Guided VectorTM, which is a nucleic acid vector comprising nucleotide sequences encoding CRISPR/Cas components.

[00034] We also managed to achieve desirable targeted killing of *E. coli* cells using a similar set-up, except that *E. coli* Type IE Cas and Cascade were used, together with a cognate array targeting host cell *E. coli* chromosomal DNA (data not shown). In this case, a vector was used comprising (in 5' to 3' direction) a promoter controlling the expression of Cas3, Cas8e, Cas11, Cas7, Cas5 and Cas6 in an operon.

Materials and methods

[00035] *E. coli* MG1655 was grown in lysogeny broth (LB) with shaking (250 rpm) at 37 °C. When necessary, cultures were supplemented with tetracycline (10 µg/mL), and spectinomycin (400 µg/mL).

[00036] To construct a plasmid containing *C. difficile* CRISPR system under arabinose inducible pBAD promoter, *cas3*, *cas6*, *cas8b*, *cas7* and *cas5* genes from *C. difficile* were amplified and cloned in a low copy number plasmid (pSC101 ori). *cas3* was located in the beginning of the operon followed by *cas6*, *cas8b*, *cas7* and *cas5*. The adaptation module (consisting of *cas1*, *cas2*, and *cas4*) was omitted in the vector (Fig. 1A). A second plasmid containing an IPTG inducible single-spacer array targeting a chromosomal intergenic region in *E. coli* MG1655 was constructed (Fig. 1A). The spacer was cloned under control of the IPTG-inducible P_{trc} promoter, in a CloDF13 ori backbone. It contains 37 nucleotides from the genome of *E. coli* MG1655 (ctttgccgcgcgttcgtcacgtaattctcgtcgcaa) (SEQ ID NO: 26). Additionally, the 3'-CCT protospacer adjacent motif (PAM) is located adjacent to the selected target sequence in the genome of *E. coli* MG1655 (Fig. 1A).

[00037] To perform killing assays, both plasmids were transformed into *E. coli* MG1655 by electroporation. Transformants were grown in liquid LB with antibiotics to mid-log phase, and the killing efficiency was determined by serial dilution and spot plating onto LB, and LB + inducers (0.5 mM IPTG and 1 % arabinose). Viability was calculated by counting colony forming units (CFUs) on the plates and data were calculated as viable cell concentration (CFU/ml).

EXAMPLE 2. Single-Vector Cas3-Cascade & Array: Type I CRISPR-Cas system targeting *E. coli*.

[00038] A plasmid (which we call a CRISPR Guided VectorTM, CGVTM) was constructed comprising an operon with nucleotide sequences encoding a Type I Cas3 and Cascade proteins under the control of a common promoter. *C. difficile* Type IB Cas3 and Cascade was used. An adaptation module containing Cas1, Cas2 and Cas4 was omitted in the vector. A cognate CRISPR array comprising *C. difficile* repeat sequences and spacer sequence for targeting an *E. coli* host cell chromosome was also included in the vector (see Figure 2A).

[00039] The CGV was transformed into *E. coli* MG1655. Results using this synthetic operon arrangement are shown in Figure 2. In Fig 2B there is shown a dilution series (10¹–10⁵) of drop spots (5 µl) of target *E. coli* MG1655 cells harboring the CGV on synthetic medium (SM) agar plates with and without inducers. CRISPR/Cas induction resulted in more than 2-log₁₀ reductions

in viable cells of *E. coli* MG1655 (Fig 2C, grey bar). Growth in absence of induction is shown in black.

[00040] The survival of *E. coli* MG1655 upon induction was followed over time by plating the cultures in serial dilutions every 60 minutes, for 2 hours (Figure 3). Killing curves revealed that CRISPR/Cas induction mediated rapid killing of *E. coli* MG1655, generating a two-log₁₀ reduction in *E. coli* by the first 60 minutes. Fig 3B shows a dilution series (10¹–10⁶) of drop spots (5 µl) of induced and non-induced cultures of target *E. coli* MG1655 on LB agar plates.

Materials and methods

[00041] *E. coli* MG1655 was grown in synthetic medium (SM) with shaking (250 rpm) at 37 °C. Cultures were supplemented with 10 µg/mL tetracycline when required.

[00042] To construct a plasmid containing *C. difficile* CRISPR system under arabinose inducible pBAD promoter, *cas3*, *cas6*, *cas8b*, *cas7* and *cas5* genes from *C. difficile* were amplified and cloned in a low copy number plasmid (pSC101 ori). *cas3* was located in the beginning of the operon followed by *cas6*, *cas8b*, *cas7* and *cas5*. Additionally, an IPTG inducible single-spacer array targeting a chromosomal intergenic region in *E. coli* MG1655 was included in the vector under control of the IPTG-inducible P_{trc} promoter (Fig 2A). It contains 37 nucleotides from the PKS gene (previously integrated into the genome of *E. coli* MG1655) (gtttggcgatggcgcggtgtgtgtgtgtcttcggcgt) (SEQ ID NO: 27). Additionally, the 3'-CCT protospacer adjacent motif (PAM) is located adjacent to the selected target sequence in the genome of *E. coli* MG1655.

[00043] The CGV was transformed into *E. coli* MG1655 by electroporation. Transformants were grown in liquid SM with antibiotics to mid-log phase, and the killing efficiency was determined by serial dilution and spot plating onto LB, and LB + inducers (0.5 mM IPTG and 1 % arabinose). Viability was calculated by counting colony forming units (CFUs) on the plates and data were calculated as viable cell concentration (CFU/ml).

[00044] To perform killing curves, *E. coli* MG1655 harboring the CGV was grown in liquid SM with antibiotics to mid-log phase. The culture was divided into two tubes and either inducers (0.5 mM IPTG and 1 % arabinose) or PBS were added. Survival of the strain was followed over time by plating the cultures in serial dilutions (10^1 – 10^6) of drop spots (5 μ l) every 60 minutes, for 2 h, on SM plates with antibiotics. Survival frequency was calculated by counting colony forming units (CFUs) on the plates and data were calculated as viable cell concentration (CFU/ml).

EXAMPLE 3. Precision killing of target strain *E. coli* MG1655 in a microbiome.

[00045] An artificial microbial consortium was constructed to study the efficiency of the CGV carrying the CRISPR-Cas system of *C. difficile*, to specifically target *E. coli* MG1655 in the presence of other microbes, mimicking the human microbiome.

[00046] The synthetic consortium consisted of three strains (two different species) with differential antibiotic resistance profiles: a streptomycin-resistant *E. coli* MG1655 (target strain), an ampicillin-resistant *E. coli* Top10, and a chloramphenicol-resistant *Lactococcus lactis* NZ9000. To create the consortium, bacterial cultures were grown separately in Brain Heart Infusion broth (BHI, optimal growth medium for *L. lactis*) to mid-log phase and mixed in fresh BHI broth with and without inducers. After 1 h induction at 30 °C, the composition of the consortium was determined by counting viable colonies on selective plates. Induction of the CRISPR system in the mixed community, resulted in >10-fold killing of target *E. coli* MG1655, while leaving *E. coli* Top10 and *L. lactis* NZ9000 cell populations unharmed (Figure 4A). In Fig 4B there is shown a dilution series (10^1 – 10^5) of drop spots (5 µl) of the synthetic consortium after 1 h induction on BHI agar plates.

[00047] Additionally, CRISPR killing of target strain *E. coli* MG1655 in the synthetic microbial consortium was compared to a pure culture (ie, target strain *E. coli* MG1655 that is not mixed with another strain or species). Unexpectedly, in both conditions, killing of 4 logs was achieved when plated on BHI agar plates with inducers (Figure 5A). Thus, surprisingly the killing in the microbiome setting was as efficient as the killing in pure culture. In Fig 5B there is shown a dilution series (10^1 – 10^5) of drop spots (5 µl) of the synthetic consortium and *E. coli* MG1655 in pure culture on BHI agar plates with and without inducers.

Materials and methods

[00048] *E. coli* MG1655, *E. coli* Top10, and *Lactococcus lactis* NZ9000 were grown in BHI broth with shaking (250 rpm) at 30 °C. Cultures were supplemented with 1000 µg/mL streptomycin, 100 µg/mL ampicillin, or 10 µg/mL chloramphenicol, respectively.

[00049] To create the consortium, bacterial cultures were grown in BHI with appropriate antibiotics to mid-log phase. Cultures were washed twice in PBS to remove the antibiotics and mixed in fresh BHI broth. The mixed culture was spotted onto BHI plates with streptomycin, ampicillin or chloramphenicol to quantify the initial concentration of *E. coli* MG1655, *E. coli* Top10 and *L.*

lactis NZ9000, respectively. The mixed culture was divided into two tubes and either inducers (0.5 mM IPTG and 1 % arabinose) or PBS were added. After 1 h induction at 30 °C, the composition of the consortium was calculated by counting colony forming units (CFUs) on selective plates and data were calculated as viable cell concentration (CFU/ml).

EXAMPLE 4. Use of Promoter Repression in Vector Amplification Strains

[00050] We engineered an *E coli* Top10 production strain cell population comprising plasmid CGV DNA and an expressible sequence encoding a Tet repressor (TetR). The DNA comprised a Cas9-encoding nucleotide sequence under the control of a Tet promoter (pLtetO-1 promoter). The promoter is normally constitutively ON, but it was repressed by TetR in our cells. Thus, in this way we could successfully culture the cells and amplify the CGV without observing adverse toxicity due to Cas9 expression.

[00051] In an experiment in the absence of repression, we did not observe any colonies of production strain bacteria, and we surmise that this was due to Cas9 toxicity. We believe, in addition to providing a way of increasing CGV yield (eg, for subsequent packaging into phage or non-self-replicative transduction particles), our method using repression can minimize selection for mutations in the DNA that would otherwise be forced by higher Cas9 expression and cutting (eg, due to CGV cutting).

References

[00052] Mutalik *et al*, Nat Methods. 2013 Apr;10(4):354-60. doi: 10.1038/nmeth. 2404. Epub 2013 Mar 10, "Precise and reliable gene expression via standard transcription and translation initiation elements".

TABLE 1: Example Bacteria

Optionally, the target host cells are cells of a genus or species selected from this Table and/or the production strain cells are cells of a genus or species selected from this Table

Abiotrophia	Acidocella	Actinomyces	Alkalilimnicola	Aquaspirillum
<i>Abiotrophia defectiva</i>	<i>Acidocella aminolytica</i>	<i>Actinomyces bovis</i>	<i>Alkalilimnicola ehrlichii</i>	<i>Aquaspirillum polymorphum</i>
Acaricomes	<i>Acidocella facilis</i>	<i>Actinomyces denticolens</i>	Alkaliphilus	<i>Aquaspirillum</i>
<i>Acaricomes phytoseiuli</i>	Acidomonas	<i>Actinomyces europaeus</i>	<i>Alkaliphilus oremlandii</i>	<i>putridiconchylum</i>
Acetitomaculum	<i>Acidomonas methanolica</i>	<i>Actinomyces georgiae</i>	<i>Alkaliphilus transvaalensis</i>	<i>Aquaspirillum serpens</i>
<i>Acetitomaculum ruminis</i>	Acidothermus	<i>Actinomyces gerencseriae</i>	Allochroomatium	Aquimarina
Acetivibrio	<i>Acidothermus cellulolyticus</i>	<i>Actinomyces</i>	<i>Allochroomatium vinosum</i>	<i>Aquimarina latercula</i>
<i>Acetivibrio cellulolyticus</i>	Acidovorax	<i>hordeovulneris</i>	Alloiococcus	Arcanobacterium
<i>Acetivibrio ethanolognens</i>	<i>Acidovorax anthurii</i>	<i>Actinomyces howellii</i>	<i>Alloiococcus otitis</i>	<i>Arcanobacterium</i>
<i>Acetivibrio multivorans</i>	<i>Acidovorax caeni</i>	<i>Actinomyces hyovaginalis</i>	Allokutzneria	<i>haemolyticum</i>
Acetoanaerobium	<i>Acidovorax cattleayae</i>	<i>Actinomyces israelii</i>	<i>Allokutzneria albata</i>	<i>Arcanobacterium pyogenes</i>
<i>Acetoanaerobium noterae</i>	<i>Acidovorax citrulli</i>	<i>Actinomyces johnsonii</i>	Altererythrobacter	Archangium
Acetobacter	<i>Acidovorax defluvi</i>	<i>Actinomyces meyeri</i>	<i>Altererythrobacter</i>	<i>Archangium gephyra</i>
<i>Acetobacter aceti</i>	<i>Acidovorax delafieldii</i>	<i>Actinomyces naeslundii</i>	<i>ishigakiensis</i>	Arcobacter
<i>Acetobacter cerevisiae</i>	<i>Acidovorax facilis</i>	<i>Actinomyces neuvi</i>	Altermonas	<i>Arcobacter butzleri</i>
<i>Acetobacter cibinongensis</i>	<i>Acidovorax konjaci</i>	<i>Actinomyces odontolyticus</i>	<i>Altermonas haloplanktis</i>	<i>Arcobacter cryaerophilus</i>
<i>Acetobacter estunensis</i>	<i>Acidovorax temperans</i>	<i>Actinomyces oris</i>	<i>Altermonas macleodii</i>	<i>Arcobacter halophilus</i>
<i>Acetobacter fabarum</i>	<i>Acidovorax valerianellae</i>	<i>Actinomyces radingae</i>	Alysiella	<i>Arcobacter nitrofigilis</i>
<i>Acetobacter ghanensis</i>	Acinetobacter	<i>Actinomyces slackii</i>	<i>Alysiella crassa</i>	<i>Arcobacter skirrowii</i>
<i>Acetobacter indonesiensis</i>	<i>Acinetobacter baumannii</i>		<i>Alysiella filiformis</i>	

<i>Acetobacter lovaniensis</i>	<i>Acinetobacter baylyi</i>	<i>Actinomyces turicensis</i>	Aminobacter	Arthodomonas
<i>Acetobacter malorum</i>	<i>Acinetobacter bouvetii</i>	<i>Actinomyces viscosus</i>	<i>Aminobacter aganoensis</i>	<i>Arthodomonas aquaeolei</i>
<i>Acetobacter nitrogenifigens</i>	<i>Acinetobacter calcoaceticus</i>	Actinoplanes	<i>Aminobacter aminovorans</i>	Arsenophonus
<i>Acetobacter oeni</i>	<i>Acinetobacter gerneri</i>	<i>Actinoplanes auranticolor</i>	<i>Aminobacter niigataensis</i>	<i>Arsenophonus nasoniae</i>
<i>Acetobacter orientalis</i>	<i>Acinetobacter haemolyticus</i>	<i>Actinoplanes brasiliensis</i>	Aminobacterium	
<i>Acetobacter orleanensis</i>	<i>Acinetobacter johnsonii</i>	<i>Actinoplanes consettensis</i>	<i>Aminobacterium mobile</i>	Arthrobacter
<i>Acetobacter pasteurianus</i>	<i>Acinetobacter junii</i>	<i>Actinoplanes deccanensis</i>	Aminomonas	<i>Arthrobacter agilis</i>
<i>Acetobacter pomorum</i>	<i>Acinetobacter lwoffii</i>	<i>Actinoplanes derwentensis</i>	<i>Aminomonas paucivorans</i>	<i>Arthrobacter albus</i>
<i>Acetobacter senegalensis</i>	<i>Acinetobacter parvus</i>	<i>Actinoplanes digitalis</i>	Ammoniphilus	<i>Arthrobacter aureus</i>
<i>Acetobacter xylinus</i>	<i>Acinetobacter radioresistens</i>	<i>Actinoplanes durhamensis</i>	<i>Ammoniphilus oxalaticus</i>	<i>Arthrobacter</i>
Acetobacterium	<i>Acinetobacter schindleri</i>	<i>Actinoplanes ferrugineus</i>	<i>Ammoniphilus oxalivorans</i>	<i>chlorophenolicus</i>
<i>Acetobacterium bakii</i>	<i>Acinetobacter soli</i>	<i>Actinoplanes globisporus</i>	Amphibacillus	<i>Arthrobacter citreus</i>
<i>Acetobacterium carbinolicum</i>	<i>Acinetobacter tandooi</i>	<i>Actinoplanes humidus</i>	<i>Amphibacillus xylanus</i>	<i>Arthrobacter crystallopoietes</i>
<i>Acetobacterium dehalogenans</i>	<i>Acinetobacter tjernbergiae</i>	<i>Actinoplanes italicus</i>	Amphritea	<i>Arthrobacter cummingsii</i>
<i>Acetobacterium fimetarium</i>	<i>Acinetobacter townieri</i>	<i>Actinoplanes liguriensis</i>	<i>Amphritea balenae</i>	<i>Arthrobacter globiformis</i>
<i>Acetobacterium malicum</i>	<i>Acinetobacter ursingii</i>	<i>Actinoplanes lobatus</i>	<i>Amphritea japonica</i>	<i>Arthrobacter</i>
<i>Acetobacterium paludosum</i>	<i>Acinetobacter venetianus</i>	<i>Actinoplanes missouriensis</i>	Amycolatopsis	<i>histidinovorans</i>
<i>Acetobacterium tundrae</i>	Acrocarpospora	<i>Actinoplanes palleronii</i>	<i>Amycolatopsis alba</i>	<i>Arthrobacter ilicis</i>
<i>Acetobacterium wieringae</i>	<i>Acrocarpospora corrugata</i>	<i>Actinoplanes philippinensis</i>	<i>Amycolatopsis albidoflavus</i>	<i>Arthrobacter luteus</i>
<i>Acetobacterium woodii</i>	<i>Acrocarpospora</i>	<i>Actinoplanes rectilineatus</i>	<i>Amycolatopsis azurea</i>	<i>Arthrobacter methylotrophus</i>
Acetofilamentum	<i>macrocephala</i>	<i>Actinoplanes regularis</i>	<i>Amycolatopsis coloradensis</i>	<i>Arthrobacter mysorens</i>
<i>Acetofilamentum rigidum</i>	<i>Acrocarpospora</i>	<i>Actinoplanes</i>	<i>Amycolatopsis lurida</i>	<i>Arthrobacter nicotianae</i>
	<i>pleiomorpha</i>		<i>Amycolatopsis mediterranei</i>	<i>Arthrobacter nicotinovorans</i>

Acetohalobium	Actibacter	<i>teichomyceticus</i>	<i>Amycolatopsis rifamycinica</i>	<i>Arthrobacter oxydans</i>
<i>Acetohalobium arabaticum</i>	<i>Actibacter sediminis</i>	<i>Actinoplanes utahensis</i>	<i>Amycolatopsis rubida</i>	<i>Arthrobacter pascens</i>
Acetomicrobium	Actinoalloteichus	Actinopolyspora	<i>Amycolatopsis sulphurea</i>	<i>Arthrobacter</i>
<i>Acetomicrobium faecale</i>	<i>Actinoalloteichus</i>	<i>Actinopolyspora halophila</i>	<i>Amycolatopsis tolypomycina</i>	<i>phenanthrenivorans</i>
<i>Acetomicrobium flavidum</i>	<i>cyanogriseus</i>	<i>Actinopolyspora</i>	Anabaena	<i>Arthrobacter</i>
Acetonema	<i>Actinoalloteichus</i>	<i>mortivallis</i>	<i>Anabaena cylindrica</i>	<i>polychromogenes</i>
<i>Acetonema longum</i>	<i>hymeniacidonis</i>	Actinosynnema	<i>Anabaena flos-aquae</i>	<i>Arthrobacter protophormiae</i>
Acetothermus	<i>Actinoalloteichus spitiensis</i>	<i>Actinosynnema mirum</i>	<i>Anabaena variabilis</i>	<i>Arthrobacter</i>
<i>Acetothermus paucivorans</i>	Actinobacillus	Actinotalea	Anaeroarcus	<i>psychrolactophilus</i>
Acholeplasma	<i>Actinobacillus capsulatus</i>	<i>Actinotalea fermentans</i>	<i>Anaeroarcus burkinensis</i>	<i>Arthrobacter ramosus</i>
<i>Acholeplasma axanthum</i>	<i>Actinobacillus delphimicola</i>	Aerococcus	Anaerobaculum	<i>Arthrobacter sulfonivorans</i>
<i>Acholeplasma brassicae</i>	<i>Actinobacillus hominis</i>	<i>Aerococcus sanguinicola</i>	<i>Anaerobaculum mobile</i>	<i>Arthrobacter sulfureus</i>
<i>Acholeplasma cavigenitalium</i>	<i>Actinobacillus indolicus</i>	<i>Aerococcus urinae</i>	Anaerobiospirillum	<i>Arthrobacter uratoxydans</i>
<i>Acholeplasma equifetale</i>	<i>Actinobacillus lignieresii</i>	<i>Aerococcus urinaeaequi</i>	<i>Anaerobiospirillum</i>	<i>Arthrobacter ureafaciens</i>
<i>Acholeplasma granularum</i>	<i>Actinobacillus minor</i>	<i>Aerococcus urinaehominis</i>	<i>succiniciproducens</i>	<i>Arthrobacter viscosus</i>
<i>Acholeplasma hippikon</i>	<i>Actinobacillus muris</i>	<i>Aerococcus viridans</i>	<i>Anaerobiospirillum thomastii</i>	<i>Arthrobacter woluwensis</i>
<i>Acholeplasma laidlawii</i>	<i>Actinobacillus</i>	Aeromicrobium	Anaerococcus	Asaia
<i>Acholeplasma modicum</i>	<i>pleuropneumoniae</i>	<i>Aeromicrobium erythreum</i>	<i>Anaerococcus hydrogenalis</i>	<i>Asaia bogorensis</i>
<i>Acholeplasma morum</i>	<i>Actinobacillus porcinus</i>	Aeromonas	<i>Anaerococcus lactolyticus</i>	Asanoa
<i>Acholeplasma multilocale</i>	<i>Actinobacillus rossii</i>	<i>Aeromonas</i>	<i>Anaerococcus prevotii</i>	<i>Asanoa ferruginea</i>
<i>Acholeplasma oculi</i>	<i>Actinobacillus scotiae</i>	<i>allosaccharophila</i>	<i>Anaerococcus tetradius</i>	Asticcacaulis
<i>Acholeplasma palmae</i>	<i>Actinobacillus seminis</i>	<i>Aeromonas bestiarum</i>	<i>Anaerococcus vaginalis</i>	<i>Asticcacaulis biprosthecium</i>
<i>Acholeplasma parvum</i>	<i>Actinobacillus succinogenes</i>	<i>Aeromonas caviae</i>		<i>Asticcacaulis excentricus</i>

<i>Acholeplasma pleciae</i>	<i>Actinobacillus suis</i>	<i>Aeromonas encheleia</i>	Anaerofustis	Atopobacter
<i>Acholeplasma vituli</i>	<i>Actinobacillus ureae</i>	<i>Aeromonas enteropelogenes</i>	<i>Anaerofustis stercorihominis</i>	<i>Atopobacter phocae</i>
Achromobacter	Actinobaculum		Anaeromusa	Atopobium
<i>Achromobacter denitrificans</i>	<i>Actinobaculum massiliense</i>	<i>Aeromonas eucrenophila</i>	<i>Anaeromusa acidaminophila</i>	<i>Atopobium fossor</i>
<i>Achromobacter insolitus</i>	<i>Actinobaculum schaalii</i>	<i>Aeromonas ichthiosmia</i>	Anaeromyxobacter	<i>Atopobium minutum</i>
<i>Achromobacter piechaudii</i>	<i>Actinobaculum suis</i>	<i>Aeromonas jandaei</i>	<i>Anaeromyxobacter dehalogenans</i>	<i>Atopobium parvulum</i>
<i>Achromobacter ruhlandii</i>	<i>Actinomyces urinale</i>	<i>Aeromonas media</i>		<i>Atopobium rimae</i>
<i>Achromobacter spanius</i>	Actinocatenispora	<i>Aeromonas popoffii</i>	Anaerorhabdus	<i>Atopobium vaginae</i>
Acidaminobacter	<i>Actinocatenispora rupis</i>	<i>Aeromonas sobria</i>	<i>Anaerorhabdus furcosa</i>	Aureobacterium
<i>Acidaminobacter hydrogeniformans</i>	<i>Actinocatenispora thailandica</i>	<i>Aeromonas veronii</i>	Anaerosinus	<i>Aureobacterium barkeri</i>
		Agrobacterium	<i>Anaerosinus glycerini</i>	Aurobacterium
Acidaminococcus	<i>Actinocatenispora sera</i>	<i>Agrobacterium gelatinovorum</i>	Anaerovirgula	<i>Aurobacterium liquefaciens</i>
<i>Acidaminococcus fermentans</i>	Actinocorallia		<i>Anaerovirgula multivorans</i>	Avibacterium
<i>Acidaminococcus intestini</i>	<i>Actinocorallia aurantiaca</i>	Agrococcus	Ancalomicrobium	<i>Avibacterium avium</i>
Acidicaldus	<i>Actinocorallia aurea</i>	<i>Agrococcus citreus</i>	<i>Ancalomicrobium adetum</i>	<i>Avibacterium gallinarum</i>
<i>Acidicaldus organivorans</i>	<i>Actinocorallia cavernae</i>	<i>Agrococcus jenensis</i>	Ancyllobacter	<i>Avibacterium paragallinarum</i>
Acidimicrobium	<i>Actinocorallia glomerata</i>	Agromonas	<i>Ancyllobacter aquaticus</i>	<i>Avibacterium volantium</i>
<i>Acidimicrobium ferrooxidans</i>	<i>Actinocorallia herbida</i>	<i>Agromonas oligotrophica</i>	Aneurinibacillus	Azoarcus
Acidiphilium	<i>Actinocorallia libanotica</i>	Agromyces	<i>Aneurinibacillus aneurinilyticus</i>	<i>Azoarcus indigenus</i>
<i>Acidiphilium acidophilum</i>	<i>Actinocorallia longicatena</i>	<i>Agromyces fucosus</i>	<i>Aneurinibacillus migulanus</i>	<i>Azoarcus toluyticus</i>
<i>Acidiphilium angustum</i>	Actinomadura	<i>Agromyces hippuratus</i>	<i>Aneurinibacillus</i>	<i>Azoarcus toluvorans</i>
<i>Acidiphilium cryptum</i>	<i>Actinomadura alba</i>	<i>Agromyces luteolus</i>		
<i>Acidiphilium multivorum</i>	<i>Actinomadura atramentaria</i>	<i>Agromyces mediolanus</i>	<i>thermoaerophilus</i>	

<i>Acidiphilium organovorum</i>	<i>Actinomadura</i>	<i>Agromyces ramosus</i>	Angiococcus	Azohydromonas
<i>Acidiphilium rubrum</i>	<i>bangladeshensis</i>	<i>Agromyces rhizosphaerae</i>	<i>Angiococcus disciformis</i>	<i>Azohydromonas australica</i>
Acidisoma	<i>Actinomadura catellatispora</i>	Akkermansia	Angulomicrobium	<i>Azohydromonas lata</i>
<i>Acidisoma sibiricum</i>	<i>Actinomadura chibensis</i>	<i>Akkermansia muciniphila</i>	<i>Angulomicrobium tetraedrale</i>	Azomonas
<i>Acidisoma tundrae</i>	<i>Actinomadura chokortensis</i>	Albidiferax	Anoxybacillus	<i>Azomonas agilis</i>
Acidisphaera	<i>Actinomadura citrea</i>	<i>Albidiferax ferrireducens</i>	<i>Anoxybacillus pushchinoensis</i>	<i>Azomonas insignis</i>
<i>Acidisphaera rubrifaciens</i>	<i>Actinomadura coerulea</i>	Albidovulum	Aquabacterium	<i>Azomonas macrocytogenes</i>
Acidithiobacillus	<i>Actinomadura echinospora</i>	<i>Albidovulum inexpectatum</i>	<i>Aquabacterium commune</i>	Azorhizobium
<i>Acidithiobacillus albertensis</i>	<i>Actinomadura fibrosa</i>	Alcaligenes	<i>Aquabacterium parvum</i>	<i>Azorhizobium caulinodans</i>
<i>Acidithiobacillus caldus</i>	<i>Actinomadura formosensis</i>	<i>Alcaligenes denitrificans</i>		Azorhizophilus
<i>Acidithiobacillus ferrooxidans</i>	<i>Actinomadura hibisca</i>	<i>Alcaligenes faecalis</i>		<i>Azorhizophilus paspali</i>
<i>Acidithiobacillus thiooxidans</i>	<i>Actinomadura kijaniata</i>	Alcanivorax		Azospirillum
Acidobacterium	<i>Actinomadura latina</i>	<i>Alcanivorax borkumensis</i>		<i>Azospirillum brasilense</i>
<i>Acidobacterium capsulatum</i>	<i>Actinomadura livida</i>	<i>Alcanivorax jadensis</i>		<i>Azospirillum halopraeferens</i>
	<i>Actinomadura</i>	Algicola		<i>Azospirillum irakense</i>
	<i>luteofluorescens</i>	<i>Algicola bacteriolytica</i>		Azotobacter
	<i>Actinomadura macra</i>	Alicyclobacillus		<i>Azotobacter beijerinckii</i>
	<i>Actinomadura madurae</i>	<i>Alicyclobacillus</i>		<i>Azotobacter chroococcum</i>
	<i>Actinomadura oligospora</i>	<i>disulfidooxidans</i>		<i>Azotobacter nigricans</i>
	<i>Actinomadura pelletieri</i>	<i>Alicyclobacillus</i>		<i>Azotobacter salinestris</i>
	<i>Actinomadura rubrobrunea</i>	<i>sendaiensis</i>		<i>Azotobacter vinelandii</i>
	<i>Actinomadura rugatobispora</i>	<i>Alicyclobacillus vulcanalis</i>		
	<i>Actinomadura umbrina</i>			

<i>Actinomadura verrucosopora</i>	Alishewanella			
<i>Actinomadura vinacea</i>	<i>Alishewanella fetalis</i>			
<i>Actinomadura viridilutea</i>	Alkalibacillus			
<i>Actinomadura viridis</i>	<i>Alkalibacillus haloalkaliphilus</i>			
<i>Actinomadura yumaensis</i>				
Bacillus	Bacteroides	Bibersteinia	Borrelia	Brevinema
[see below]	<i>Bacteroides cacciae</i>	<i>Bibersteinia trehalosi</i>	<i>Borrelia afzelii</i>	<i>Brevinema andersonii</i>
Bacteriovorax	<i>Bacteroides coagulans</i>	Bifidobacterium	<i>Borrelia americana</i>	Brevundimonas
<i>Bacteriovorax stolpii</i>	<i>Bacteroides eggerthii</i>	<i>Bifidobacterium adolescentis</i>	<i>Borrelia burgdorferi</i>	<i>Brevundimonas alba</i>
	<i>Bacteroides fragilis</i>	<i>Bifidobacterium angulatum</i>	<i>Borrelia carolinensis</i>	<i>Brevundimonas aurantiaca</i>
	<i>Bacteroides galacturonicus</i>	<i>Bifidobacterium animalis</i>	<i>Borrelia coriaceae</i>	<i>Brevundimonas diminuta</i>
	<i>Bacteroides helcogenes</i>	<i>Bifidobacterium asteroides</i>	<i>Borrelia garinii</i>	<i>Brevundimonas intermedia</i>
	<i>Bacteroides ovatus</i>	<i>Bifidobacterium bifidum</i>	<i>Borrelia japonica</i>	<i>Brevundimonas subvibrioides</i>
	<i>Bacteroides pectinophilus</i>	<i>Bifidobacterium boum</i>	Bosea	<i>Brevundimonas vancouverii</i>
	<i>Bacteroides pyogenes</i>	<i>Bifidobacterium breve</i>	<i>Bosea minatitlanensis</i>	<i>Brevundimonas variabilis</i>
	<i>Bacteroides salyerstiae</i>	<i>Bifidobacterium catenulatum</i>	<i>Bosea thiooxidans</i>	<i>Brevundimonas vesicularis</i>
	<i>Bacteroides stercoris</i>	<i>Bifidobacterium choerinum</i>	Brachybacterium	Brochothrix
	<i>Bacteroides suis</i>	<i>Bifidobacterium coryneforme</i>	<i>Brachybacterium</i>	<i>Brochothrix campestris</i>
	<i>Bacteroides tectus</i>	<i>Bifidobacterium cuniculi</i>	<i>alimentarium</i>	<i>Brochothrix thermosphacta</i>
	<i>Bacteroides thetaiotaomicron</i>	<i>Bifidobacterium dentium</i>	<i>Brachybacterium faecium</i>	

<i>Bacteroides uniformis</i>	<i>Bifidobacterium gallicum</i>	<i>Brachybacterium</i>	Brucella
<i>Bacteroides ureolyticus</i>	<i>Bifidobacterium gallinarum</i>	<i>paraconglomeratum</i>	<i>Brucella canis</i>
<i>Bacteroides vulgatus</i>	<i>Bifidobacterium indicum</i>	<i>Brachybacterium rhamnosum</i>	<i>Brucella neotomae</i>
Balnearium	<i>Bifidobacterium longum</i>	<i>Brachybacterium</i>	Bryobacter
<i>Balnearium lithotrophicum</i>	<i>Bifidobacterium</i>	<i>tyrofermentans</i>	<i>Bryobacter aggregatus</i>
Balneatrix	<i>magnumBifidobacterium</i>	Brachyspira	Burkholderia
<i>Balneatrix alpica</i>	<i>merycicum</i>	<i>Brachyspira alvinipulli</i>	<i>Burkholderia ambifaria</i>
Balneola	<i>Bifidobacterium minimum</i>	<i>Brachyspira hyodysenteriae</i>	<i>Burkholderia andropogonis</i>
<i>Balneola vulgaris</i>	<i>Bifidobacterium</i>	<i>Brachyspira innocens</i>	<i>Burkholderia anthina</i>
Barnesiella	<i>pseudocatenulatum</i>	<i>Brachyspira murchii</i>	<i>Burkholderia caledonica</i>
<i>Barnesiella viscericola</i>	<i>Bifidobacterium</i>	<i>Brachyspira pilosicoli</i>	<i>Burkholderia caryophylli</i>
Bartonella	<i>pseudolongum</i>		<i>Burkholderia cenocepacia</i>
<i>Bartonella alsatica</i>	<i>Bifidobacterium pullorum</i>	Bradyrhizobium	<i>Burkholderia cepacia</i>
<i>Bartonella bacilliformis</i>	<i>Bifidobacterium ruminantium</i>	<i>Bradyrhizobium canariense</i>	<i>Burkholderia cocovenenans</i>
<i>Bartonella clarridgeiae</i>	<i>Bifidobacterium saeculare</i>	<i>Bradyrhizobium elkanii</i>	<i>Burkholderia dolosa</i>
<i>Bartonella doshiae</i>	<i>Bifidobacterium subtile</i>	<i>Bradyrhizobium japonicum</i>	<i>Burkholderia fungorum</i>
<i>Bartonella elizabethae</i>	<i>Bifidobacterium</i>	<i>Bradyrhizobium liaoningense</i>	<i>Burkholderia glathei</i>
<i>Bartonella grahamii</i>	<i>thermophilum</i>	Brenneria	<i>Burkholderia glumae</i>
<i>Bartonella henselae</i>	Bilophila	<i>Brenneria alni</i>	<i>Burkholderia graminis</i>
<i>Bartonella rochalimae</i>	<i>Bilophila wadsworthia</i>	<i>Brenneria nigrifluens</i>	<i>Burkholderia kururiensis</i>
<i>Bartonella vinsonii</i>	Biostraticola	<i>Brenneria quercina</i>	<i>Burkholderia multivorans</i>
Bavaricoccus	<i>Biostraticola tofi</i>	<i>Brenneria quercina</i>	<i>Burkholderia phenazinium</i>
<i>Bavaricoccus seileri</i>		<i>Brenneria salicis</i>	<i>Burkholderia plantarii</i>

Bdellovibrio	Bizionia	Brevibacillus	<i>Burkholderia pyrrocinia</i>
<i>Bdellovibrio bacteriovorus</i>	<i>Bizionia argentinensis</i>	<i>Brevibacillus agri</i>	<i>Burkholderia silvaticola</i>
<i>Bdellovibrio exovorus</i>	Blastobacter	<i>Brevibacillus borstelensis</i>	<i>Burkholderia stabilis</i>
Beggiatoa	<i>Blastobacter capsulatus</i>	<i>Brevibacillus brevis</i>	<i>Burkholderia thailandensis</i>
<i>Beggiatoa alba</i>	<i>Blastobacter denitrificans</i>	<i>Brevibacillus centrosporus</i>	<i>Burkholderia tropica</i>
Beijerinckia	Blastococcus	<i>Brevibacillus choshinensis</i>	<i>Burkholderia unamae</i>
<i>Beijerinckia derxii</i>	<i>Blastococcus aggregatus</i>	<i>Brevibacillus invocatus</i>	<i>Burkholderia vietnamiensis</i>
<i>Beijerinckia fluminensis</i>	<i>Blastococcus saxosidens</i>	<i>Brevibacillus laterosporus</i>	Butiauxella
<i>Beijerinckia indica</i>	Blastochloris	<i>Brevibacillus parabrevis</i>	<i>Butiauxella agrestis</i>
<i>Beijerinckia mobilis</i>	<i>Blastochloris viridis</i>	<i>Brevibacillus reuszeri</i>	<i>Butiauxella brennerae</i>
Belliella	Blastomonas	Brevibacterium	<i>Butiauxella ferruginea</i>
<i>Belliella baltica</i>	<i>Blastomonas natatoria</i>	<i>Brevibacterium abidum</i>	<i>Butiauxella gaviniae</i>
Bellilinea	Blastopirellula	<i>Brevibacterium album</i>	<i>Butiauxella izardii</i>
<i>Bellilinea caldifistulae</i>	<i>Blastopirellula marina</i>	<i>Brevibacterium aurantiacum</i>	<i>Butiauxella noackiae</i>
Belnapia	Blautia	<i>Brevibacterium celere</i>	<i>Butiauxella warmboldiae</i>
<i>Belnapia modensis</i>	<i>Blautia coccoides</i>	<i>Brevibacterium epidermidis</i>	Butyrivibrio
Bergeriella	<i>Blautia hansenii</i>	<i>Brevibacterium</i>	<i>Butyrivibrio fibrisolvens</i>
<i>Bergeriella denitrificans</i>	<i>Blautia producta</i>	<i>frigoritolerans</i>	<i>Butyrivibrio hungatei</i>
Beutenbergia	<i>Blautia wexlerae</i>	<i>Brevibacterium halotolerans</i>	<i>Butyrivibrio proteoclasticus</i>
<i>Beutenbergia cavernae</i>	Bogoriella	<i>Brevibacterium iodinum</i>	
	<i>Bogoriella caseolytica</i>	<i>Brevibacterium linens</i>	
	Bordetella	<i>Brevibacterium lyticum</i>	
	<i>Bordetella avium</i>	<i>Brevibacterium mcbrellneri</i>	

	<i>Bordetella bronchiseptica</i>	<i>Brevibacterium otitidis</i>
	<i>Bordetella hinzii</i>	<i>Brevibacterium oxydans</i>
	<i>Bordetella holmesii</i>	<i>Brevibacterium paucivorans</i>
	<i>Bordetella parapertussis</i>	<i>Brevibacterium stationis</i>
	<i>Bordetella pertussis</i>	
	<i>Bordetella petrii</i>	
	<i>Bordetella trematum</i>	
Bacillus		
<i>B. acidiceles</i>	<i>B. aminovorans</i>	<i>B. taeanensis</i>
<i>B. acidicola</i>	<i>B. anyolyticus</i>	<i>B. tequilensis</i>
<i>B. acidiproducens</i>	<i>B. andreesenii</i>	<i>B. thermantarcticus</i>
<i>B. acidocaldarius</i>	<i>B. aneurinilyticus</i>	<i>B. thermoaerophilus</i>
<i>B. acidoterrestris</i>	<i>B. anthracis</i>	<i>B. thermoamylovorans</i>
<i>B. aeolius</i>	<i>B. aquimaris</i>	<i>B. thermocatenulatus</i>
<i>B. aerius</i>	<i>B. arenosi</i>	<i>B. thermocloacae</i>
<i>B. aerophilus</i>	<i>B. arseniciselenatis</i>	<i>B. thermocopriae</i>
<i>B. agaradhaerens</i>	<i>B. arsenicus</i>	<i>B. thermodenitrificans</i>
<i>B. agri</i>	<i>B. aurantiacus</i>	<i>B. thermoglucosidasius</i>
<i>B. aidiensis</i>	<i>B. arvi</i>	<i>B. thermolactis</i>
<i>B. akibai</i>	<i>B. aryabhatai</i>	<i>B. thermoleovorans</i>
<i>B. alcalophilus</i>	<i>B. asahii</i>	<i>B. thermophilus</i>
		<i>B. lautus</i>
		<i>B. lehensis</i>
		<i>B. lentimorbus</i>
		<i>B. lentus</i>
		<i>B. licheniformis</i>
		<i>B. ligniniphilus</i>
		<i>B. litoralis</i>
		<i>B. locisalis</i>
		<i>B. luciferensis</i>
		<i>B. luteolus</i>
		<i>B. luteus</i>
		<i>B. macauensis</i>
		<i>B. macerans</i>

<i>B. algicola</i>	<i>B. atrophaeus</i>	<i>B. herbersteinensis</i>	<i>B. thermoruber</i>	<i>B. macquariensis</i>
<i>B. alginolyticus</i>	<i>B. axarquienensis</i>	<i>B. horikoshii</i>	<i>B. thermosphaericus</i>	<i>B. macyae</i>
<i>B. alkalidiazotrophicus</i>	<i>B. azotofixans</i>	<i>B. homeckiae</i>	<i>B. thiaminolyticus</i>	<i>B. malacitensis</i>
<i>B. alkalinitrilicus</i>	<i>B. azotoformans</i>	<i>B. horti</i>	<i>B. thioparans</i>	<i>B. mannaniolyticus</i>
<i>B. alkalisediminis</i>	<i>B. badius</i>	<i>B. hui-zhouensis</i>	<i>B. thuringiensis</i>	<i>B. mariisflavi</i>
<i>B. alkalitelluris</i>	<i>B. barbaricus</i>	<i>B. humi</i>	<i>B. tianshenii</i>	<i>B. marismortui</i>
<i>B. alitudinis</i>	<i>B. bataviensis</i>	<i>B. hwajinpoensis</i>	<i>B. tryoxylicola</i>	<i>B. marmarensis</i>
<i>B. alveayuensis</i>	<i>B. beijingensis</i>	<i>B. idriensis</i>	<i>B. tusciae</i>	<i>B. massiliensis</i>
<i>B. alvei</i>	<i>B. benzoovorans</i>	<i>B. indicus</i>	<i>B. validus</i>	<i>B. megaterium</i>
<i>B. amyloliquefaciens</i>	<i>B. beringensis</i>	<i>B. infantis</i>	<i>B. vallismortis</i>	<i>B. mesonae</i>
• <i>B.</i>	<i>B. berkeleyi</i>	<i>B. infernus</i>	<i>B. vedderi</i>	<i>B. methanolicus</i>
<i>a. subsp. amyloliquefaciens</i>	<i>B. beveridgei</i>	<i>B. insolitus</i>	<i>B. velezensis</i>	<i>B. methylotrophicus</i>
• <i>B. a. subsp. plantarum</i>	<i>B. bogoriensis</i>	<i>B. invictae</i>	<i>B. vietnamensis</i>	<i>B. migulanus</i>
<i>B. dipsosauri</i>	<i>B. boroniphilus</i>	<i>B. iranensis</i>	<i>B. vireti</i>	<i>B. mojavenensis</i>
<i>B. drenensis</i>	<i>B. borstelensis</i>	<i>B. isabeliae</i>	<i>B. vulcani</i>	<i>B. mucilaginosus</i>
<i>B. edaphicus</i>	<i>B. brevis Migula</i>	<i>B. isronensis</i>	<i>B. wakoensis</i>	<i>B. muralis</i>
<i>B. ehimensis</i>	<i>B. butanolivorans</i>	<i>B. jeotgali</i>	<i>B. weihenstephanensis</i>	<i>B. murimartini</i>
<i>B. eiseniae</i>	<i>B. canaveralius</i>	<i>B. kaustophilus</i>	<i>B. xiamenensis</i>	<i>B. mycoides</i>
<i>B. enclensis</i>	<i>B. carboniphilus</i>	<i>B. kobensis</i>	<i>B. xiaoxiensis</i>	<i>B. naganoensis</i>
<i>B. endophlyticus</i>	<i>B. cecembensis</i>	<i>B. kochii</i>	<i>B. zhanjiangensis</i>	<i>B. nanhaiensis</i>
<i>B. endoradicis</i>	<i>B. cellulostilyticus</i>	<i>B. kokeshiiformis</i>	<i>B. peoriae</i>	<i>B. nanhaiisediminis</i>
<i>B. farraginis</i>	<i>B. centrosporus</i>	<i>B. koreensis</i>	<i>B. persepolensis</i>	<i>B. nealsonii</i>
	<i>B. cereus</i>	<i>B. korlensis</i>	<i>B. persicus</i>	<i>B. neidei</i>

<i>B. fastidiosus</i>	<i>B. chagannorensis</i>	<i>B. kribbensis</i>	<i>B. pervagus</i>	<i>B. neizhouensis</i>
<i>B. fengquiensis</i>	<i>B. chitinolyticus</i>	<i>B. krulwichiae</i>	<i>B. plakortidis</i>	<i>B. niabensis</i>
<i>B. firmus</i>	<i>B. chondroitinus</i>	<i>B. laevolacticus</i>	<i>B. pocheonensis</i>	<i>B. niacini</i>
<i>B. flexus</i>	<i>B. choshinensis</i>	<i>B. larvae</i>	<i>B. polygona</i>	<i>B. novalis</i>
<i>B. foraminis</i>	<i>B. chungangensis</i>	<i>B. laterosporus</i>	<i>B. polymyxa</i>	<i>B. oceanisediminis</i>
<i>B. fordii</i>	<i>B. cibi</i>	<i>B. salexigens</i>	<i>B. popilliae</i>	<i>B. odysseyi</i>
<i>B. formosus</i>	<i>B. circulans</i>	<i>B. saliphilus</i>	<i>B. pseudocalophilus</i>	<i>B. okhensis</i>
<i>B. fortis</i>	<i>B. clarkii</i>	<i>B. schlegelii</i>	<i>B. pseudofirmus</i>	<i>B. okuhidensis</i>
<i>B. fumarioli</i>	<i>B. clausii</i>	<i>B. sediminis</i>	<i>B. pseudomycoides</i>	<i>B. oleronius</i>
<i>B. funiculus</i>	<i>B. coagulans</i>	<i>B. selenatarsenatis</i>	<i>B. psychrodurans</i>	<i>B. oryzaecorticis</i>
<i>B. fusiformis</i>	<i>B. coahuilensis</i>	<i>B. selenitireducens</i>	<i>B. psychrophilus</i>	<i>B. oshimensis</i>
<i>B. galactophilus</i>	<i>B. colnii</i>	<i>B. seohaeanensis</i>	<i>B. psychrosaccharolyticus</i>	<i>B. pabuli</i>
<i>B. galactosidilyticus</i>	<i>B. composti</i>	<i>B. shacheensis</i>	<i>B. psychrotolerans</i>	<i>B. pakistanensis</i>
<i>B. galliciensis</i>	<i>B. curdolanolyticus</i>	<i>B. shackletonii</i>	<i>B. pulvifaciens</i>	<i>B. pallidus</i>
<i>B. gelatini</i>	<i>B. cycloheptanicus</i>	<i>B. siamensis</i>	<i>B. pumilus</i>	<i>B. pallidus</i>
<i>B. gibsonii</i>	<i>B. cytotoxicus</i>	<i>B. silvestris</i>	<i>B. purgationiresistens</i>	<i>B. panacisoli</i>
<i>B. ginsengi</i>	<i>B. daliensis</i>	<i>B. simplex</i>	<i>B. pycnus</i>	<i>B. panaciterrae</i>
<i>B. ginsengihumi</i>	<i>B. decisifrondis</i>	<i>B. siralis</i>	<i>B. qingdaonensis</i>	<i>B. pantothenticus</i>
<i>B. ginsengisoli</i>	<i>B. decolorationis</i>	<i>B. smithii</i>	<i>B. qingshengii</i>	<i>B. parabrevis</i>
<i>B. globisporus</i> (eg. <i>B.</i>	<i>B. deserti</i>	<i>B. soli</i>	<i>B. reuszeri</i>	<i>B. paraflexus</i>
g. subsp. <i>Globisporus</i> ; or <i>B.</i>		<i>B. solimangrovi</i>	<i>B. rhizosphaerae</i>	<i>B. pasteurii</i>
g. subsp. <i>Marinus</i>)		<i>B. solisalsi</i>	<i>B. rigui</i>	<i>B. patagoniensis</i>
		<i>B. songklensis</i>	<i>B. ruriis</i>	

<i>B. sonorensis</i>	<i>B. safensis</i>
<i>B. sphaericus</i>	<i>B. salarius</i>
<i>B. sporothermodurans</i>	
<i>B. stearothermophilus</i>	
<i>B. stratosphericus</i>	
<i>B. subterraneus</i>	
<i>B. subtilis</i> (eg. <i>B.</i>	
<i>s. subsp. Inaquosorum</i> ; or <i>B.</i>	
<i>s. subsp. Spizizeni</i> ; or <i>B.</i>	
<i>s. subsp. Subtilis</i>)	
Caenimonas	Cardiobacterium
<i>Caenimonas koreensis</i>	<i>Cardiobacterium hominis</i>
Caldalkalibacillus	Carnimonas
<i>Caldalkalibacillus uzonensis</i>	<i>Carnimonas nigrificans</i>
Caldanaerobacter	<i>Carnobacterium</i>
<i>Caldanaerobacter subterraneus</i>	<i>Carnobacterium</i>
Caldanaerobius	<i>alterfunditum</i>
<i>Caldanaerobius fijiensis</i>	<i>Carnobacterium divergens</i>
<i>Caldanaerobius</i>	<i>Carnobacterium funditum</i>
<i>polysaccharolyticus</i>	<i>Carnobacterium gallinarum</i>
<i>Caldanaerobius zeae</i>	<i>Carnobacterium</i>
	<i>maltaromaticum</i>
	Chryseobacterium
	<i>Chryseobacterium</i>
	<i>balustinum</i>

Caldanaerovirga	<i>Campylobacter rectus</i>	<i>Carnobacterium mobile</i>	Citrobacter
<i>Caldanaerovirga acetigenens</i>	<i>Campylobacter showae</i>	<i>Carnobacterium viridans</i>	<i>C. anlonaticus</i>
Caldicellulosiruptor	<i>Campylobacter sputorum</i>	Caryophanon	<i>C. braakii</i>
<i>Caldicellulosiruptor bescii</i>	<i>Campylobacter upsaliensis</i>	<i>Caryophanon latum</i>	<i>C. diversus</i>
<i>Caldicellulosiruptor kristjanssonii</i>	Capnocytophaga	<i>Caryophanon tenue</i>	<i>C. farmeri</i>
<i>Caldicellulosiruptor owensensis</i>	<i>Capnocytophaga canimorsus</i>	Catellatospora	<i>C. freundii</i>
	<i>Capnocytophaga cynodegmi</i>	<i>Catellatospora citrea</i>	<i>C. gillenii</i>
	<i>Capnocytophaga gingivalis</i>	<i>Catellatospora</i>	<i>C. koseri</i>
	<i>Capnocytophaga granulosa</i>	<i>methionotrophica</i>	<i>C. murlinae</i>
	<i>Capnocytophaga haemolytica</i>	Catenococcus	<i>C. pasteurii</i> ^[1]
	<i>Capnocytophaga ochracea</i>	<i>Catenococcus thiocycli</i>	<i>C. rodentium</i>
	<i>Capnocytophaga sputigena</i>		<i>C. sedlakii</i>
			<i>C. werkmanii</i>
			<i>C. youngae</i>
			Clostridium
			(see below)
			Coccochloris
			<i>Coccochloris elabens</i>
			Corynebacterium
			<i>Corynebacterium flavescens</i>
			<i>Corynebacterium variabile</i>

Clostridium

Clostridium absonum, *Clostridium aceticum*, *Clostridium acetireducens*, *Clostridium acetobutylicum*, *Clostridium acidisoli*, *Clostridium aciditolerans*,
Clostridium acidurici, *Clostridium aerotolerans*, *Clostridium aestuarii*, *Clostridium akagii*, *Clostridium aldenense*, *Clostridium aldrichii*, *Clostridium*
algidicarni, *Clostridium algidixylanolyticum*, *Clostridium algifacis*, *Clostridium algoriphilum*, *Clostridium alkalicellulosi*, *Clostridium aminophilum*,
Clostridium aminovalericum, *Clostridium amygdalinum*, *Clostridium amylolyticum*, *Clostridium arbuti*, *Clostridium arcticum*, *Clostridium argentinense*,
Clostridium asparagiforme, *Clostridium aurantibutyricum*, *Clostridium autoethanogenum*, *Clostridium baratii*, *Clostridium barkeri*, *Clostridium bartlettii*,
Clostridium bejerinckii, *Clostridium bifermentans*, *Clostridium boltae*, *Clostridium bornimense*, *Clostridium botulinum*, *Clostridium bowmanii*, *Clostridium*
bryantii, *Clostridium butyricum*, *Clostridium cadaveris*, *Clostridium caenicola*, *Clostridium caminithermale*, *Clostridium carboxidivorans*, *Clostridium carnis*,
Clostridium cavendishii, *Clostridium celatum*, *Clostridium celerecrescens*, *Clostridium cellobioparum*, *Clostridium cellulofragmentans*, *Clostridium*
cellulolyticum, *Clostridium cellulosi*, *Clostridium cellulovorans*, *Clostridium chartatabidum*, *Clostridium chauvoei*, *Clostridium chromiireducens*, *Clostridium*
citroniae, *Clostridium clariflavum*, *Clostridium clostridioforme*, *Clostridium coccoides*, *Clostridium cochlearium*, *Clostridium colletant*, *Clostridium colicanis*,
Clostridium colinum, *Clostridium collagenovorans*, *Clostridium cylindrosporum*, *Clostridium difficile*, *Clostridium diolis*, *Clostridium disporicum*,
Clostridium drakei, *Clostridium durum*, *Clostridium estertheticum*, *Clostridium estertheticum laramiense*,
Clostridium fallax, *Clostridium felsineum*, *Clostridium fervidum*, *Clostridium finetarium*, *Clostridium formicaceticum*, *Clostridium frigidicarnis*, *Clostridium*
frigoris, *Clostridium ganghwense*, *Clostridium gasigenes*, *Clostridium ghonii*, *Clostridium glycolicum*, *Clostridium glycyrrhizinilyticum*, *Clostridium grantii*,
Clostridium haemolyticum, *Clostridium halophilum*, *Clostridium hastiforme*, *Clostridium hathewayi*, *Clostridium herbivorans*, *Clostridium hiranonis*,
Clostridium histolyticum, *Clostridium homopropionicum*, *Clostridium huakuii*, *Clostridium hungatei*, *Clostridium hydrogeniformans*, *Clostridium*
hydroxybenzoicum, *Clostridium hylemonae*, *Clostridium jejuense*, *Clostridium indolis*, *Clostridium innocuum*, *Clostridium intestinale*, *Clostridium irregulare*,
Clostridium isatidis, *Clostridium josui*, *Clostridium kluyveri*, *Clostridium lactatifermentans*, *Clostridium lacusfryxellense*, *Clostridium laramiense*, *Clostridium*
lavalense, *Clostridium lentocellum*, *Clostridium lentoputrescens*, *Clostridium leptum*, *Clostridium limosum*, *Clostridium litorale*, *Clostridium lituseburens*,
Clostridium ljungdahlii, *Clostridium lortetii*, *Clostridium lundense*, *Clostridium magnum*, *Clostridium malenominatum*, *Clostridium mangenotii*, *Clostridium*
mayombei, *Clostridium methoxybenzovorans*, *Clostridium methylpentosum*, *Clostridium neopropionicum*, *Clostridium nexile*, *Clostridium nitrophenolicum*,
Clostridium novyi, *Clostridium oceanicum*, *Clostridium orbiscindens*, *Clostridium oroticum*, *Clostridium oxalicum*, *Clostridium papyrosolvans*, *Clostridium*
paradoxum, *Clostridium paraperfringens* (Alias: *C. welchii*), *Clostridium parapatrificum*, *Clostridium pascui*, *Clostridium pasteurianum*, *Clostridium*

peptidivorans, *Clostridium perenne*, *Clostridium perfringens*, *Clostridium pfennigii*, *Clostridium phytofermentans*, *Clostridium piliforme*, *Clostridium polysaccharolyticum*, *Clostridium populeti*, *Clostridium propionicum*, *Clostridium proteoclasticum*, *Clostridium proteolyticum*, *Clostridium psychrophilum*, *Clostridium puniceum*, *Clostridium purinilyticum*, *Clostridium putrefaciens*, *Clostridium putrificum*, *Clostridium quercicolum*, *Clostridium quinii*, *Clostridium ramosum*, *Clostridium rectum*, *Clostridium roseum*, *Clostridium saccharobutylicum*, *Clostridium saccharogumia*, *Clostridium saccharolyticum*, *Clostridium saccharoperbutylacetonicum*, *Clostridium sardiniense*, *Clostridium sartagoforme*, *Clostridium scatologenes*, *Clostridium schirmacherense*, *Clostridium scindens*, *Clostridium septicum*, *Clostridium sordellii*, *Clostridium sphenoides*, *Clostridium spiroforme*, *Clostridium sporogenes*, *Clostridium sporosphaeroides*, *Clostridium stercorarium*, *Clostridium stercorarium leptospartum*, *Clostridium stercorarium stercorarium*, *Clostridium stercorarium thermolacticum*, *Clostridium sticklandii*, *Clostridium straminisolvens*, *Clostridium subterminale*, *Clostridium sufflavum*, *Clostridium sulfidigenes*, *Clostridium symbiosum*, *Clostridium tagluense*, *Clostridium tepidiprofundii*, *Clostridium termitidis*, *Clostridium tertium*, *Clostridium tetani*, *Clostridium tetanomorphum*, *Clostridium thermaceteticum*, *Clostridium thermautotrophicum*, *Clostridium thermoacaliphilum*, *Clostridium thermobutylicum*, *Clostridium thermocellum*, *Clostridium thermocopriae*, *Clostridium thermohydrosulfuricum*, *Clostridium thermolacticum*, *Clostridium thermopalmarum*, *Clostridium thermopapyrolyticum*, *Clostridium thermosaccharolyticum*, *Clostridium thermosuccinogenes*, *Clostridium thermosulfurigenes*, *Clostridium thiosulfatireducens*, *Clostridium tyrobutyricum*, *Clostridium uliginosum*, *Clostridium ulunense*, *Clostridium villosum*, *Clostridium vincentii*, *Clostridium viride*, *Clostridium xylanolyticum*, *Clostridium xylanovorans*

Dactylosporangium	Deinococcus	Delftia	Echinicola
<i>Dactylosporangium aurantiacum</i>	<i>Deinococcus aerius</i>	<i>Delftia acidovorans</i>	<i>Echinicola pacifica</i>
<i>Dactylosporangium fulvum</i>	<i>Deinococcus apachensis</i>	Desulfovibrio	<i>Echinicola vietnamensis</i>
<i>Dactylosporangium matsuzakiense</i>	<i>Deinococcus aquaticus</i>	<i>Desulfovibrio desulfuricans</i>	
<i>Dactylosporangium roseum</i>	<i>Deinococcus aquatilis</i>	Diplococcus	
<i>Dactylosporangium thailandense</i>	<i>Deinococcus caeni</i>	<i>Diplococcus pneumoniae</i>	
<i>Dactylosporangium vinaceum</i>	<i>Deinococcus radiodurans</i>		
	<i>Deinococcus radiophilus</i>		

Enterobacter			Faecalibacterium	Flavobacterium
<i>E. aerogenes</i>	<i>Enterobacter kobei</i>		<i>Faecalibacterium prausnitzii</i>	<i>Flavobacterium antarcticum</i>
<i>E. amnigenus</i>	<i>E. ludwigii</i>		Fangia	<i>Flavobacterium aquatile</i>
<i>E. agglomerans</i>	<i>E. mori</i>		<i>Fangia hongkongensis</i>	<i>Flavobacterium</i>
<i>E. arachidis</i>	<i>E. nimipressuralis</i>		Fastidiosipila	<i>aquidurensis</i>
<i>E. asburiae</i>	<i>E. oryzae</i>		<i>Fastidiosipila sanguinis</i>	<i>Flavobacterium balustinum</i>
<i>E. cancerogenus</i>	<i>E. pulveris</i>		Fusobacterium	<i>Flavobacterium croceum</i>
<i>E. cloacae</i>	<i>E. pyrinus</i>		<i>Fusobacterium nucleatum</i>	<i>Flavobacterium cucumis</i>
<i>E. cowanii</i>	<i>E. radicincitans</i>			<i>Flavobacterium</i>
<i>E. dissolvens</i>	<i>E. taylorae</i>			<i>daejeonense</i>
<i>E. gergoviae</i>	<i>E. turicensis</i>			<i>Flavobacterium defluvii</i>
<i>E. helveticus</i>	<i>E. sakazakii</i>	<i>Enterobacter soli</i>		<i>Flavobacterium degerlachii</i>
<i>E. hormaechei</i>	Enterococcus			<i>Flavobacterium</i>
<i>E. intermedius</i>	<i>Enterococcus durans</i>			<i>denitrificans</i>
	<i>Enterococcus faecalis</i>			<i>Flavobacterium filum</i>
	<i>Enterococcus faecium</i>			<i>Flavobacterium flevense</i>
	Erwinia			<i>Flavobacterium frigidarium</i>
	<i>Erwinia haponitici</i>			<i>Flavobacterium mizutaii</i>
	Escherichia			<i>Flavobacterium</i>
	<i>Escherichia coli</i>			<i>okeanokoites</i>

Gaetbulibacter	Haemophilus	Ideonella	Janibacter
<i>Gaetbulibacter saemankumensis</i>	<i>Haemophilus aegyptius</i>	<i>Ideonella azotifigens</i>	<i>Janibacter anophelis</i>
Gallibacterium	<i>Haemophilus aphrophilus</i>	Idiomarina	<i>Janibacter corallicola</i>
<i>Gallibacterium anatis</i>	<i>Haemophilus felis</i>	<i>Idiomarina abyssalis</i>	<i>Janibacter limosus</i>
Gallicola	<i>Haemophilus gallinarum</i>	<i>Idiomarina ballica</i>	<i>Janibacter melonis</i>
<i>Gallicola barnesae</i>	<i>Haemophilus haemolyticus</i>	<i>Idiomarina fontislapidosi</i>	<i>Janibacter terrae</i>
Garciella	<i>Haemophilus influenzae</i>	<i>Idiomarina loihiensis</i>	Jannaschia
<i>Garciella nitratreducens</i>	<i>Haemophilus paracuniculus</i>	<i>Idiomarina ramblicola</i>	<i>Jannaschia cystaurens</i>
Geobacillus	<i>Haemophilus parahaemolyticus</i>	<i>Idiomarina seosinensis</i>	<i>Jannaschia helgolandensis</i>
<i>Geobacillus thermoglucosidasius</i>	<i>Haemophilus parainfluenzae</i>	<i>Idiomarina zobellii</i>	<i>Jannaschia pohangensis</i>
<i>Geobacillus stearothermophilus</i>	<i>Haemophilus</i>	Ignatzschineria	<i>Jannaschia rubra</i>
Geobacter	<i>paraphrohaemolyticus</i>	<i>Ignatzschineria larvae</i>	
<i>Geobacter bemidjiensis</i>	<i>Haemophilus parasuis</i>		Janthinobacterium
<i>Geobacter brenensis</i>	<i>Haemophilus pitmaniae</i>	Ignavigranum	<i>Janthinobacterium</i>
<i>Geobacter chapelleyi</i>	Hafnia	<i>Ignavigranum ruoffiae</i>	<i>aggaricidannosum</i>
<i>Geobacter grbiciae</i>	<i>Hafnia alvei</i>	Ilumatobacter	<i>Janthinobacterium lividum</i>
<i>Geobacter hydrogenophilus</i>	Hahella	<i>Ilumatobacter fluminis</i>	Jejuia
<i>Geobacter lovleyi</i>	<i>Hahella ganghwensis</i>	Ilyobacter	<i>Jejuia pallidilutea</i>
<i>Geobacter metallireducens</i>	Halakalibacillus	<i>Ilyobacter delafeldii</i>	Jeotgalibacillus
<i>Geobacter pelophilus</i>	<i>Halakalibacillus halophilus</i>	<i>Ilyobacter insuetus</i>	<i>Jeotgalibacillus</i>
<i>Geobacter pickeringii</i>	Helicobacter	<i>Ilyobacter polytropus</i>	<i>alimentarius</i>
<i>Geobacter sulfurreducens</i>	<i>Helicobacter pylori</i>	<i>Ilyobacter tartaricus</i>	Jeotgalicoccus
			<i>Jeotgalicoccus halotolerans</i>

Geodermatophilus				
<i>Geodermatophilus obscurus</i>				
Gluconacetobacter				
<i>Gluconacetobacter xylinus</i>				
Gordonia				
<i>Gordonia rubripertincta</i>				
Kaistia	Labeledella	<i>Listeria ivanovii</i>	Micrococcus	Nesterenkonia
<i>Kaistia adipata</i>	<i>Labeledella gwakjiensis</i>	<i>L. marthii</i>	<i>Micrococcus luteus</i>	<i>Nesterenkonia holobia</i>
<i>Kaistia soli</i>	Labrenzia	<i>L. monocytogenes</i>	<i>Micrococcus lylae</i>	Nocardia
Kangiella	<i>Labrenzia aggregata</i>	<i>L. newyorkensis</i>	Moraxella	<i>Nocardia argentinensis</i>
<i>Kangiella aquimarina</i>	<i>Labrenzia alba</i>	<i>L. riparia</i>	<i>Moraxella bovis</i>	<i>Nocardia corallina</i>
<i>Kangiella koreensis</i>	<i>Labrenzia alexandrii</i>	<i>L. rocourtae</i>	<i>Moraxella nonliquefaciens</i>	<i>Nocardia</i>
	<i>Labrenzia marina</i>	<i>L. seeligeri</i>	<i>Moraxella osloensis</i>	<i>otitidiscaviarum</i>
Kerstersia	Labrys	<i>L. weihenstephanensis</i>	Nakamurella	
<i>Kerstersia gylorum</i>	<i>Labrys methylaniphilus</i>	<i>L. welshimeri</i>	<i>Nakamurella multipartita</i>	
Kiloniella	<i>Labrys miyagiensis</i>	Listonella	Nannocystis	
<i>Kiloniella laminariae</i>	<i>Labrys monachus</i>	<i>Listonella anguillarum</i>	<i>Nannocystis pusilla</i>	
Klebsiella	<i>Labrys okinawensis</i>	Macrococcus	Natranaerobius	
<i>K. granulomatis</i>	<i>Labrys portucalensis</i>	<i>Macrococcus bovicus</i>	<i>Natranaerobius</i>	
<i>K. oxytoca</i>		Marinobacter	<i>thermophilus</i>	
<i>K. pneumoniae</i>	Lactobacillus	<i>Marinobacter algicola</i>	<i>Natranaerobius trueperi</i>	

<i>K. terrigena</i>	[see below]	<i>Marinobacter bryozoonum</i>	Naxibacter
<i>K. variicola</i>	Laceyella	<i>Marinobacter flavimaris</i>	<i>Naxibacter alkaliolerans</i>
Kluyvera	<i>Laceyella putida</i>	Meiothermus	Neisseria
<i>Kluyvera ascorbata</i>	Lechevalieria	<i>Meiothermus ruber</i>	<i>Neisseria cinerea</i>
Kocuria	<i>Lechevalieria aerocolonigenes</i>	Methylophilus	<i>Neisseria dentrificans</i>
<i>Kocuria roasea</i>	Legionella	<i>Methylophilus</i>	<i>Neisseria gonorrhoeae</i>
<i>Kocuria varians</i>	[see below]	<i>methylophilus</i>	<i>Neisseria lactamica</i>
Kurthia	Listeria	Microbacterium	<i>Neisseria mucosa</i>
<i>Kurthia zopfii</i>	<i>L. aquatica</i>	<i>Microbacterium</i>	<i>Neisseria sicca</i>
	<i>L. boorlie</i>	<i>ammoniaophilum</i>	<i>Neisseria subflava</i>
	<i>L. cornellensis</i>	<i>Microbacterium arborescens</i>	Neptunomonas
	<i>L. fleischmannii</i>	<i>Microbacterium liquefaciens</i>	<i>Neptunomonas japonica</i>
	<i>L. floridensis</i>	<i>Microbacterium oxydans</i>	
	<i>L. grandensis</i>		
	<i>L. grayi</i>		
	<i>L. innocua</i>		
Lactobacillus			
<i>L. acetotolerans</i>	<i>L. cateniformis</i>	<i>L. mali</i>	<i>L. parakefiri</i>
<i>L. acidifarinae</i>	<i>L. ceti</i>	<i>L. manihotivorans</i>	<i>L. paralimentarius</i>
<i>L. acidipiscis</i>	<i>L. coleohominis</i>	<i>L. mindensis</i>	<i>L. paraplantarum</i>
<i>L. acidophilus</i>	<i>L. collinoides</i>	<i>L. mucosae</i>	<i>L. pentosus</i>
			<i>L. sakei</i>
			<i>L. salivarius</i>
			<i>L. sanfranciscensis</i>
			<i>L. satsumensis</i>

<i>Lactobacillus agilis</i>	<i>L. compositi</i>	<i>L. murinus</i>	<i>L. perolens</i>	<i>L. secaliphilus</i>
<i>L. algidus</i>	<i>L. concavus</i>	<i>L. nagelii</i>	<i>L. plantarum</i>	<i>L. sharpeae</i>
<i>L. alimentarius</i>	<i>L. coryniformis</i>	<i>L. namurensis</i>	<i>L. pontis</i>	<i>L. siliginis</i>
<i>L. amyolyticus</i>	<i>L. crispatus</i>	<i>L. nantensis</i>	<i>L. protectus</i>	<i>L. spicheri</i>
<i>L. amylophilus</i>	<i>L. crustorum</i>	<i>L. oligofermentans</i>	<i>L. psittaci</i>	<i>L. suebicus</i>
<i>L. amylohydrophilus</i>	<i>L. curvatus</i>	<i>L. oris</i>	<i>L. remini</i>	<i>L. thailandensis</i>
<i>L. amylovorus</i>	<i>L. delbrueckii</i> subsp.	<i>L. panis</i>	<i>L. reuteri</i>	<i>L. ulunensis</i>
<i>L. animalis</i>	<i>bulgaricus</i>	<i>L. pantheris</i>	<i>L. rhamnosus</i>	<i>L. vaccinosus</i>
<i>L. antri</i>	<i>L. delbrueckii</i> subsp.	<i>L. parabrevis</i>	<i>L. rimae</i>	<i>L. vaginalis</i>
<i>L. apodemi</i>	<i>delbrueckii</i>	<i>L. parabuchneri</i>	<i>L. rogosa</i>	<i>L. versmoldensis</i>
<i>L. aviarius</i>	<i>L. delbrueckii</i> subsp. <i>lactis</i>	<i>L. paracasei</i>	<i>L. rossiae</i>	<i>L. vini</i>
<i>L. bif fermentans</i>	<i>L. dextrinicus</i>	<i>L. paracollinoides</i>	<i>L. ruminis</i>	<i>L. vitulinus</i>
<i>L. brevis</i>	<i>L. diolivorans</i>	<i>L. parafarraginis</i>	<i>L. saerimneri</i>	<i>L. zeae</i>
<i>L. buchneri</i>	<i>L. equi</i>	<i>L. homohiochii</i>	<i>L. jensenii</i>	<i>L. zymae</i>
<i>L. camelliae</i>	<i>L. equigenerosi</i>	<i>L. iners</i>	<i>L. johnsonii</i>	<i>L. gastricus</i>
<i>L. casei</i>	<i>L. farraginis</i>	<i>L. ingluviei</i>	<i>L. kalixensis</i>	<i>L. ghanensis</i>
<i>L. kitasatonis</i>	<i>L. farciminis</i>	<i>L. intestinalis</i>	<i>L. kefirano faciens</i>	<i>L. graminis</i>
<i>L. kunkei</i>	<i>L. fermentum</i>	<i>L. fuchuensis</i>	<i>L. kefir</i>	<i>L. hammesii</i>
<i>L. leichmannii</i>	<i>L. formicalis</i>	<i>L. gallinarum</i>	<i>L. kinchii</i>	<i>L. hamsteri</i>
<i>L. lindneri</i>	<i>L. fructivorans</i>	<i>L. gasseri</i>	<i>L. helveticus</i>	<i>L. harbinensis</i>
<i>L. malefermentans</i>	<i>L. frumenti</i>		<i>L. hilgardii</i>	<i>L. hayakienensis</i>

Legionella

<i>Legionella adalaidensis</i>	<i>Legionella drancourtii</i>	<i>Candidatus Legionella jeonii</i>	<i>Legionella quinlivanii</i>
<i>Legionella anisa</i>	<i>Legionella dresdenensis</i>	<i>Legionella jordanis</i>	<i>Legionella rowbothamii</i>
<i>Legionella beliardensis</i>	<i>Legionella drozanskii</i>	<i>Legionella lansingensis</i>	<i>Legionella rubrilucens</i>
<i>Legionella birminghamsensis</i>	<i>Legionella dumoffii</i>	<i>Legionella londiniensis</i>	<i>Legionella sainthelenis</i>
<i>Legionella bozemanae</i>	<i>Legionella erythra</i>	<i>Legionella longbeachae</i>	<i>Legionella santacrucis</i>
<i>Legionella brunensis</i>	<i>Legionella fairfieldensis</i>	<i>Legionella lytica</i>	<i>Legionella shakespearei</i>
<i>Legionella busanensis</i>	<i>Legionella fallonii</i>	<i>Legionella maceachernii</i>	<i>Legionella spiritensis</i>
<i>Legionella cardiaca</i>	<i>Legionella feeleyi</i>	<i>Legionella massiliensis</i>	<i>Legionella steelei</i>
<i>Legionella cherrii</i>	<i>Legionella geestiana</i>	<i>Legionella micdadei</i>	<i>Legionella steigerwaltii</i>
<i>Legionella cincinnatiensis</i>	<i>Legionella genomospecies</i>	<i>Legionella monrovia</i>	<i>Legionella taurinensis</i>
<i>Legionella clemsonensis</i>	<i>Legionella gormanii</i>	<i>Legionella moravica</i>	<i>Legionella tucsonensis</i>
<i>Legionella donaldsonii</i>	<i>Legionella gratiana</i>	<i>Legionella nagasakiensis</i>	<i>Legionella tunisiensis</i>
	<i>Legionella gresilensis</i>	<i>Legionella nautarum</i>	<i>Legionella wadsworthii</i>
	<i>Legionella hackeliae</i>	<i>Legionella norrlandica</i>	<i>Legionella waltersii</i>
	<i>Legionella impletisoli</i>	<i>Legionella oakridgensis</i>	<i>Legionella worsleiensis</i>
	<i>Legionella israelensis</i>	<i>Legionella parisiensis</i>	<i>Legionella yabuuchiiae</i>
	<i>Legionella jamestowniensis</i>	<i>Legionella pittsburghensis</i>	
		<i>Legionella pneumophila</i>	
		<i>Legionella quateirensis</i>	

Oceanibulbus	Paenibacillus	Prevotella	Quadrifphaera
<i>Oceanibulbus indolifex</i>	<i>Paenibacillus thiaminolyticus</i>	<i>Prevotella albensis</i>	<i>Quadrifphaera granulorum</i>
Oceanicaulis	Pantoea	<i>Prevotella amnii</i>	Quatrionococcus
<i>Oceanicaulis alexandrii</i>	<i>Pantoea agglomerans</i>	<i>Prevotella bergensis</i>	<i>Quatrionococcus</i>
Oceanicola		<i>Prevotella bivia</i>	<i>australiensis</i>
<i>Oceanicola batsensis</i>	Paracoccus	<i>Prevotella brevis</i>	
<i>Oceanicola granulosis</i>	<i>Paracoccus alcaliphilus</i>	<i>Prevotella bryantii</i>	Quinella
<i>Oceanicola nanhaiensis</i>	Paucimonas	<i>Prevotella buccae</i>	<i>Quinella ovalis</i>
Oceanimonas	<i>Paucimonas lemoignei</i>	<i>Prevotella buccalis</i>	
<i>Oceanimonas baumannii</i>	Pectobacterium	<i>Prevotella copri</i>	Ralstonia
Oceaniserpentilla	<i>Pectobacterium aroidearum</i>	<i>Prevotella dentalis</i>	<i>Ralstonia eutropha</i>
<i>Oceaniserpentilla halotidis</i>	<i>Pectobacterium atrosepticum</i>	<i>Prevotella denticola</i>	<i>Ralstonia insidiosa</i>
Oceanisphaera	<i>Pectobacterium</i>	<i>Prevotella distens</i>	<i>Ralstonia mannitolilytica</i>
<i>Oceanisphaera donghaensis</i>	<i>betavascularum</i>	<i>Prevotella histicola</i>	<i>Ralstonia pickettii</i>
<i>Oceanisphaera litoralis</i>	<i>Pectobacterium cacticida</i>	<i>Prevotella intermedia</i>	<i>Ralstonia</i>
Oceanithermus	<i>Pectobacterium carnegeiana</i>	<i>Prevotella maculosa</i>	<i>pseudosolanacearum</i>
<i>Oceanithermus desulfurans</i>	<i>Pectobacterium carotovorum</i>	<i>Prevotella marshii</i>	<i>Ralstonia syzygii</i>
<i>Oceanithermus profundus</i>	<i>Pectobacterium chrysanthemi</i>	<i>Prevotella melaninogenica</i>	<i>Ralstonia solanacearum</i>
Oceanobacillus	<i>Pectobacterium cypripedii</i>	<i>Prevotella micans</i>	Ramlibacter
<i>Oceanobacillus caeni</i>	<i>Pectobacterium rhapontici</i>	<i>Prevotella multififormis</i>	<i>Ramlibacter henchirensis</i>
Oceanospirillum	<i>Pectobacterium wasabiae</i>	<i>Prevotella nigrescens</i>	<i>Ramlibacter tataouinensis</i>
<i>Oceanospirillum linum</i>	Planococcus	<i>Prevotella oralis</i>	
	<i>Planococcus citreus</i>	<i>Prevotella oris</i>	

Planomicrobium	<i>Prevotella oulorum</i>	Raoultella
<i>Planomicrobium okeanokoites</i>	<i>Prevotella pallens</i>	<i>Raoultella ornithinolytica</i>
Plesiomonas	<i>Prevotella salivae</i>	<i>Raoultella planicola</i>
<i>Plesiomonas shigelloides</i>	<i>Prevotella stercora</i>	<i>Raoultella terrigena</i>
Proteus	<i>Prevotella tannerae</i>	Rathayibacter
<i>Proteus vulgaris</i>	<i>Prevotella timonensis</i>	<i>Rathayibacter caricis</i>
	<i>Prevotella veroralis</i>	<i>Rathayibacter festucae</i>
	Providencia	<i>Rathayibacter iranicus</i>
	<i>Providencia stuartii</i>	<i>Rathayibacter rathayi</i>
	Pseudomonas	<i>Rathayibacter toxicus</i>
	<i>Pseudomonas aeruginosa</i>	<i>Rathayibacter tritici</i>
	<i>Pseudomonas alcaligenes</i>	Rhodobacter
	<i>Pseudomonas anguillispetica</i>	<i>Rhodobacter sphaeroides</i>
	<i>Pseudomonas fluorescens</i>	Ruegeria
	<i>Pseudodalteromonas haloplanktis</i>	<i>Ruegeria gelatinovorans</i>
	<i>Pseudomonas mendocina</i>	
	<i>Pseudomonas pseudoalcaligenes</i>	
	<i>Pseudomonas putida</i>	
	<i>Pseudomonas tutzeri</i>	
	<i>Pseudomonas syringae</i>	

Psychrobacter*Psychrobacter faecalis**Psychrobacter**phenylpyruvicus*

Saccharococcus	Sagittula	Sanguibacter	Stenotrophomonas	Tatlockia
<i>Saccharococcus thermophilus</i>	<i>Sagittula stellata</i>	<i>Sanguibacter keddiei</i>	<i>Stenotrophomonas</i>	<i>Tatlockia maceachernii</i>
Saccharomonospora	Salegentibacter	<i>Sanguibacter suarezii</i>	<i>malophilus</i>	<i>Tatlockia micdadei</i>
<i>Saccharomonospora azurea</i>	<i>Salegentibacter salegens</i>	Saprosira	Streptococcus	Tenacibaculum
<i>Saccharomonospora cyanea</i>	Salimicrobium	<i>Saprosira grandis</i>	<i>Tenacibaculum</i>	<i>Tenacibaculum</i>
<i>Saccharomonospora viridis</i>	<i>Salimicrobium album</i>	Sarcina	[also see below]	<i>amylolyticum</i>
Saccharophagus	Salinibacter	<i>Sarcina maxima</i>	Streptomyces	<i>Tenacibaculum discolor</i>
<i>Saccharophagus degradans</i>	<i>Salinibacter ruber</i>	<i>Sarcina ventriculi</i>	<i>Streptomyces</i>	<i>Tenacibaculum</i>
Saccharopolyspora	Salinicoccus	Sebaldella	<i>achromogenes</i>	<i>gallaicum</i>
<i>Saccharopolyspora erythraea</i>	<i>Salinicoccus alkaliphilus</i>	<i>Sebaldella termiidis</i>	<i>Streptomyces cesalbus</i>	<i>Tenacibaculum</i>
<i>Saccharopolyspora gregorii</i>	<i>Salinicoccus hispanicus</i>		<i>Streptomyces cescaeipitosus</i>	<i>lutimaris</i>
<i>Saccharopolyspora hirsuta</i>	<i>Salinicoccus roseus</i>	Serratia	<i>Streptomyces cesdiastaticus</i>	<i>Tenacibaculum</i>
<i>Saccharopolyspora hordei</i>	Salinispora	<i>Serratia fonticola</i>	<i>Streptomyces cesexfoliatus</i>	<i>mesophilum</i>
<i>Saccharopolyspora rectivirgula</i>	<i>Salinispora arenicola</i>	<i>Serratia marcescens</i>	<i>Streptomyces fimbriatus</i>	<i>Tenacibaculum</i>
<i>Saccharopolyspora spinosa</i>	<i>Salinispora tropica</i>	Sphaerotilus	<i>Streptomyces fradiae</i>	<i>skagerrakense</i>
<i>Saccharopolyspora taberi</i>	Salinivibrio	<i>Sphaerotilus natans</i>	<i>Streptomyces fulvissimus</i>	
	<i>Salinivibrio costicola</i>		<i>Streptomyces griseoruber</i>	

Saccharothrix	Salmonella	Sphingobacterium	Streptomyces griseus	Tepidanaerobacter
<i>Saccharothrix australiensis</i>	<i>Salmonella bongori</i>	<i>Sphingobacterium multivorum</i>	<i>Streptomyces lavendulae</i>	<i>Tepidanaerobacter</i>
<i>Saccharothrix coeruleofusca</i>	<i>Salmonella enterica</i>	Staphylococcus	<i>Streptomyces</i>	<i>syntrophicus</i>
<i>Saccharothrix espanaensis</i>	<i>Salmonella subterranea</i>	[see below]	<i>phaeochromogenes</i>	Tepidibacter
<i>Saccharothrix longispora</i>	<i>Salmonella typhi</i>		<i>Streptomyces</i>	<i>Tepidibacter</i>
<i>Saccharothrix mutabilis</i>			<i>thermodiastaticus</i>	<i>formicigenes</i>
<i>Saccharothrix syringae</i>			<i>Streptomyces tubercidicus</i>	<i>Tepidibacter</i>
<i>Saccharothrix tangerinus</i>				<i>thalassicus</i>
<i>Saccharothrix texasensis</i>				Thermus
				<i>Thermus aquaticus</i>
				<i>Thermus filiformis</i>
				<i>Thermus thermophilus</i>
Staphylococcus				
<i>S. arlettae</i>	<i>S. equorum</i>	<i>S. microti</i>	<i>S. schleiferi</i>	
<i>S. agnetis</i>	<i>S. felis</i>	<i>S. muscae</i>	<i>S. sciuri</i>	
<i>S. aureus</i>	<i>S. fleuretii</i>	<i>S. nepalensis</i>	<i>S. simiae</i>	
<i>S. auricularis</i>	<i>S. gallinarum</i>	<i>S. pasteurii</i>	<i>S. simulans</i>	
<i>S. capitis</i>	<i>S. haemolyticus</i>	<i>S. petrasii</i>	<i>S. stepanovicii</i>	
<i>S. caprae</i>	<i>S. hominis</i>	<i>S. pettenkoferi</i>	<i>S. succinus</i>	
<i>S. carnosus</i>	<i>S. hyicus</i>	<i>S. piscifermentans</i>	<i>S. vitulinus</i>	
<i>S. caseolyticus</i>	<i>S. intermedius</i>	<i>S. pseudintermedius</i>	<i>S. warneri</i>	
<i>S. chromogenes</i>	<i>S. kloosii</i>	<i>S. pseudolugdunensis</i>	<i>S. xylosus</i>	

<i>S. colnii</i>	<i>S. leei</i>	<i>S. pulvereri</i>	
<i>S. condimentii</i>	<i>S. lentus</i>	<i>S. rostri</i>	
<i>S. delphini</i>	<i>S. lugdunensis</i>	<i>S. saccharolyticus</i>	
<i>S. devriesei</i>	<i>S. lutrae</i>	<i>S. saprophyticus</i>	
<i>S. epidermidis</i>	<i>S. lyticans</i>		
	<i>S. massiliensis</i>		
Streptococcus			
<i>Streptococcus agalactiae</i>	<i>Streptococcus infantarius</i>	<i>Streptococcus oristratii</i>	<i>Streptococcus thermophilus</i>
<i>Streptococcus anginosus</i>	<i>Streptococcus iniae</i>	<i>Streptococcus parasanguinis</i>	<i>Streptococcus sanguinis</i>
<i>Streptococcus bovis</i>	<i>Streptococcus intermedius</i>	<i>Streptococcus peroris</i>	<i>Streptococcus sobrinus</i>
<i>Streptococcus canis</i>	<i>Streptococcus lactarius</i>	<i>Streptococcus pneumoniae</i>	<i>Streptococcus suis</i>
<i>Streptococcus constellatus</i>	<i>Streptococcus milleri</i>	<i>Streptococcus</i>	<i>Streptococcus uberis</i>
<i>Streptococcus downei</i>	<i>Streptococcus mitis</i>	<i>pseudopneumoniae</i>	<i>Streptococcus vestibularis</i>
<i>Streptococcus dysgalactiae</i>	<i>Streptococcus mutans</i>	<i>Streptococcus pyogenes</i>	<i>Streptococcus viridans</i>
<i>Streptococcus equines</i>	<i>Streptococcus oralis</i>	<i>Streptococcus rattii</i>	<i>Streptococcus</i>
<i>Streptococcus faecalis</i>	<i>Streptococcus tigurinus</i>	<i>Streptococcus salivarius</i>	<i>zooepidemicus</i>
<i>Streptococcus ferus</i>			
Uliginosibacterium			
	Vagococcus	Vibrio	Xanthobacter
	<i>Vagococcus carniphilus</i>	<i>Vibrio aerogenes</i>	<i>Xanthobacter agilis</i>
<i>Uliginosibacterium gangwonense</i>	<i>Vagococcus elongatus</i>	<i>Vibrio aestuarians</i>	<i>Xanthobacter</i>

Ulvibacter	<i>Vagococcus fessus</i>	<i>Vibrio albensis</i>	<i>Virgibacillus</i>	<i>aminoxidans</i>
<i>Ulvibacter litoralis</i>	<i>Vagococcus fluvialis</i>	<i>Vibrio alginolyticus</i>	<i>pantothenticus</i>	<i>Xanthobacter</i>
Umezawaea	<i>Vagococcus lutrae</i>	<i>Vibrio campbellii</i>	Weissella	<i>autotrophicus</i>
<i>Umezawaea tangerina</i>	<i>Vagococcus salmoninarum</i>	<i>Vibrio cholerae</i>	<i>Weissella cibaria</i>	<i>Xanthobacter flavus</i>
Undibacterium	Variovorax	<i>Vibrio cinnamomiensis</i>	<i>Weissella confusa</i>	<i>Xanthobacter tagetidis</i>
<i>Undibacterium pigrum</i>	<i>Variovorax boronicumulans</i>	<i>Vibrio coralliilyticus</i>	<i>Weissella halotolerans</i>	<i>Xanthobacter viscosus</i>
Ureaplasma	<i>Variovorax dokdonensis</i>	<i>Vibrio cyclitrophicus</i>	<i>Weissella hellenica</i>	Xanthomonas
<i>Ureaplasma urealyticum</i>	<i>Variovorax paradoxus</i>	<i>Vibrio diazotrophicus</i>	<i>Weissella kandleri</i>	<i>Xanthomonas</i>
Ureibacillus	<i>Variovorax soli</i>	<i>Vibrio fluvialis</i>	<i>Weissella koreensis</i>	<i>albilineans</i>
<i>Ureibacillus composti</i>	Veillonella	<i>Vibrio furnissii</i>	<i>Weissella minor</i>	<i>Xanthomonas alfalfae</i>
<i>Ureibacillus suwonensis</i>	<i>Veillonella atypica</i>	<i>Vibrio gazogenes</i>	<i>Weissella</i>	<i>Xanthomonas</i>
<i>Ureibacillus terrenus</i>	<i>Veillonella cavae</i>	<i>Vibrio halotitoli</i>	<i>paramesenteroides</i>	<i>arboricola</i>
<i>Ureibacillus thermophilus</i>	<i>Veillonella criceti</i>	<i>Vibrio harveyi</i>	<i>Weissella soli</i>	<i>Xanthomonas</i>
<i>Ureibacillus thermosphaericus</i>	<i>Veillonella dispar</i>	<i>Vibrio ichthyenteri</i>	<i>Weissella thailandensis</i>	<i>axonopodis</i>
	<i>Veillonella montpellierensis</i>	<i>Vibrio mediterranei</i>	<i>Weissella viridescens</i>	<i>Xanthomonas</i>
	<i>Veillonella parvula</i>	<i>Vibrio metschnikovii</i>	Williamsia	<i>campestris</i>
	<i>Veillonella ratti</i>	<i>Vibrio mytili</i>	<i>Williamsia marianensis</i>	<i>Xanthomonas citri</i>
	<i>Veillonella rodentium</i>	<i>Vibrio natriegens</i>	<i>Williamsia maris</i>	<i>Xanthomonas codiae</i>
	Venenivibrio	<i>Vibrio navarrensis</i>	<i>Williamsia serinedens</i>	<i>Xanthomonas</i>
	<i>Venenivibrio stagnispumantis</i>	<i>Vibrio nereis</i>	Winogradskyella	<i>cucurbitae</i>
	Verminephrobacter	<i>Vibrio nigrripulchritudo</i>	<i>Winogradskyella</i>	<i>Xanthomonas</i>
	<i>Verminephrobacter eiseniae</i>	<i>Vibrio ordalii</i>	<i>thlassocola</i>	<i>euvicatoria</i>
		<i>Vibrio orientalis</i>		<i>Xanthomonas fragariae</i>

Verrucomicrobium <i>Verrucomicrobium spinosum</i>	<i>Vibrio parahaemolyticus</i>	Wolbachia	<i>Xanthomonas fuscans</i>
	<i>Vibrio pectenicida</i>	<i>Wolbachia persica</i>	<i>Xanthomonas gardneri</i>
	<i>Vibrio penaeicida</i>	Wolinella <i>Wolinella succinogenes</i>	<i>Xanthomonas hortorum</i>
	<i>Vibrio proteolyticus</i>		<i>Xanthomonas hyacinthi</i>
	<i>Vibrio shilonii</i>		<i>Xanthomonas perforans</i>
	<i>Vibrio splendidus</i>		<i>Xanthomonas phaseoli</i>
	<i>Vibrio tubiashii</i>	Zobellia <i>Zobellia galactanivorans</i>	<i>Xanthomonas pisi</i>
	<i>Vibrio vulnificus</i>		<i>Xanthomonas populi</i>
		<i>Zobellia uliginosa</i>	<i>Xanthomonas theicola</i>
		Zoogloea <i>Zoogloea ramigera</i>	<i>Xanthomonas translucens</i>
Xenophilus <i>Xenophilus azovorans</i>		<i>Zoogloea resiniphila</i>	
			<i>Xanthomonas vesicatoria</i>
			Xylella <i>Xylella fastidiosa</i>
			Xylophilus <i>Xylophilus ampelinus</i>
	Yangia <i>Yangia pacifica</i>	Zooshikella <i>Zooshikella ganghwensis</i>	Zobellella <i>Zobellella denitrificans</i>
		<i>Yersinia mollaretii</i>	<i>Zobellella taiwanensis</i>
		<i>Yersinia philomiragia</i>	
		<i>Yersinia pestis</i>	

Xenorhabdus	Yaniella	Zunongwangia	
<i>Xenorhabdus beddingii</i>	<i>Yaniella flava</i>	<i>Zunongwangia profunda</i>	Zeaxanthinibacter
<i>Xenorhabdus bovienii</i>	<i>Yaniella halotolerans</i>	Zymbacter	<i>Zeaxanthinibacter</i>
<i>Xenorhabdus cabanillasii</i>	Yeosuana	<i>Zymbacter palmae</i>	<i>enoshimensis</i>
<i>Xenorhabdus doucetiae</i>	<i>Yeosuana aromativorans</i>	Zymomonas	Zhihengliuella
<i>Xenorhabdus griffithiae</i>	Yersinia	<i>Zymomonas mobilis</i>	<i>Zhihengliuella</i>
<i>Xenorhabdus hominickii</i>	<i>Yersinia aldovae</i>	Zymophilus	<i>halotolerans</i>
<i>Xenorhabdus koppenhoeferi</i>	<i>Yersinia bercovieri</i>	<i>Zymophilus paucivorans</i>	Xylanibacterium
<i>Xenorhabdus nematophilus</i>	<i>Yersinia enterocolitica</i>	<i>Zymophilus raffinosivorans</i>	<i>Xylanibacterium ulmi</i>
<i>Xenorhabdus poinarii</i>	<i>Yersinia entomophaga</i>		
Xylanibacter	<i>Yersinia frederiksenii</i>		
<i>Xylanibacter oryzae</i>	<i>Yersinia intermedia</i>		
	<i>Yersinia kristensenii</i>		

TABLE 2: Sequences

Nucleic acid sequences herein are written in 5' to 3' direction; amino acid sequences are written in N- to C-terminal direction.

SEQ ID NO: 1 (P10)

TTCAATTTAATCATCCGGCTCGTATAATGTGTGGA

SEQ ID NO: 2 (BCD14)

GGGCCCAAGTTCACTTAAAAAGGAGATCAACAATGAAAGCAATTTTCGTACTGAAACAT
CTTAATCATGCGGTGGAGGGTTTCTAATG

SEQ ID NO: 3 (*gfp*)

ATGAGCAAAGGAGAAGAACTTTTCACTGGAGTTGTC

SEQ ID NO: 4 (example EOU)

Expression Operating Unit
(EcoRI-BglII)-3FStops-rpoC spacer-rpoC terminator-T7A1 pause-SSpB-pTrc ⁺ promoter—BCD-afGFP (XhoI-BamHI)-dbs terminator (3'UTR) GAATTC AAA AGATCTTAAGTAAGTAAGAGTATACGTATATCGGCTAA TAACGTATTAAAGCGCTTCGGCGCCTTTTTTATGGGGTATTTTCATCCCAATCCACACGTCCAACGCACAGCAAACA CCAAGTCGACCCATCAGCTGCGTGCTTTCTATGAGTCGTTGCTGCATAACTTGACAATTAATCATCCGGCTCGTATAA TGTGTGGAA-BCD-GOI- GGATCCAAACTCGAGTAAGGATCTCCAGGCATCAATAAAACGAAAGGCTCAGTCGAAAGACTGGGCCTTTTCGTTTTA TCTGTTGTTTGTGGTGAACGCTCTCTACTAGAGTCAGACTGGCTCAGCTTCGGGTGGGCCTTTCTGCGTTTATA

SEQ ID NO: 4

gaattcaaaa gatcttaagt aagtaagagt atacgtatat cggctaataa cgtattaagg cgcttcggcg cctttttta tgggggtatt
ttatcccaa tccacagtc caagcacag caaacaccac gtgcacctc tcagctcgt gctttctatg agtcgttgc gcataactg
acaattaat atccggctcg tataatgtgt ggaa- BCD-GOI -ggat ccaactcga gtaaggatct ccaggcatca aataaaacga
aaggctcagt cgaagactg ggccttctgt ttatctgtt gttgtcgtt gaacgctct tactagagtc acactggctc accttcgggt
gggcctttct gcgtttata

SEQ ID NO: 5 (Example Shine Dalgarno Sequence)

Aaagaggagaaa

SEQ ID NO: 26 (Spacer sequence)

ctttgccgcgcgttcgtcacgtaattctcgtcgaa

SEQ ID NO: 27 (Spacer sequence)

gtttggcgtggcgcggtgtggtgtgcttcggcgt

TABLE 3: Anderson Promoter Collection

SEQ ID NO:	Identifier	Sequence ^a	Measured Strength ^b
6	<u>BBa_J23119</u>	ttgacagctagctcagtcctaggtataatgctagc	n/a
7	<u>BBa_J23100</u>	ttgacggctagctcagtcctaggtacagtgctagc	1
8	<u>BBa_J23101</u>	tttacagctagctcagtcctaggtattatgctagc	0.7
9	<u>BBa_J23102</u>	ttgacagctagctcagtcctaggtactgtgctagc	0.86
10	<u>BBa_J23103</u>	ctgatatagctagctcagtcctagggattatgctagc	0.01
11	<u>BBa_J23104</u>	ttgacagctagctcagtcctaggtattgtgctagc	0.72
12	<u>BBa_J23105</u>	tttacggctagctcagtcctaggtactatgctagc	0.24
13	<u>BBa_J23106</u>	tttacggctagctcagtcctaggtatagtgctagc	0.47
14	<u>BBa_J23107</u>	tttacggctagctcagtcctaggtattatgctagc	0.36
15	<u>BBa_J23108</u>	ctgacagctagctcagtcctaggtataatgctagc	0.51
16	<u>BBa_J23109</u>	tttacagctagctcagtcctagggactgtgctagc	0.04
17	<u>BBa_J23110</u>	tttacggctagctcagtcctaggtacaatgctagc	0.33
18	<u>BBa_J23111</u>	ttgacggctagctcagtcctaggtatagtgctagc	0.58
19	<u>BBa_J23112</u>	ctgatatagctagctcagtcctagggattatgctagc	0
20	<u>BBa_J23113</u>	ctgatggctagctcagtcctagggattatgctagc	0.01
21	<u>BBa_J23114</u>	tttatggctagctcagtcctaggtacaatgctagc	0.1
22	<u>BBa_J23115</u>	tttatagctagctcagcccttggtacaatgctagc	0.15
23	<u>BBa_J23116</u>	ttgacagctagctcagtcctagggactatgctagc	0.16

24	<u>BBa_J23117</u>	ttgacagctagctcagtcctagggattgtgctagc	0.06
25	<u>BBa_J23118</u>	ttgacggctagctcagtcctaggtattgtgctagc	0.56

a: also shown in the Anderson Catalog, see <http://parts.igem.org/Promoters/Catalog/Anderson>

b: Strength is the Anderson Score (AS), eg, a strength of 1 is a AS of 1. Reported activities of the promoters are given as the relative fluorescence of plasmids in strain TG1 grown in LB media to saturation. A suitable plasmid is EX-Ptet-S-rbsRFP-P "RFP reporter" as described at http://parts.igem.org/Part:BBa_J61002; insertion of a promoter element between XbaI and SpeI sites results in a RFP reporter.

CLAIMS:

1. A nucleic acid vector for introduction into a host cell, the vector comprising a first nucleotide sequence encoding a Type I Cas3 and a second nucleotide sequence encoding one or more Cascade proteins, wherein the first and second sequences are under the control of one or more promoters comprised by the vector for expression of the proteins in the cell.
2. The vector of claim 1, wherein the vector comprises an operon for expression in the cell of the Cas3 and Cascade proteins from a Cas module, the module comprising the nucleotide sequences encoding the Cas3 and Cascade proteins, and the operon comprising the Cas module under the control of a promoter for controlling the expression of both the Cas3 and Cascade proteins.
3. The vector of claim 2, wherein
 - (a) the first sequence is between the promoter and the second sequence in the operon;
 - (b) the operon comprises no Cas-encoding nucleotide sequences between the promoter and the first nucleotide sequence; and/or
 - (c) the operon comprises (in 5' to 3' direction) the promoter, the first sequence and the second sequence.
4. The vector of any preceding claim, wherein first sequence is under the control of a promoter that has an Anderson Score (AS) of $0.5 > AS > 0.1$.
5. The vector of any preceding claim, wherein the first sequence (and optionally the second sequence) is under the control of a promoter and translation initiation site (TIS) combination that is capable of producing expression of green fluorescent protein (GFP) from a first expression operating unit (EOU) in *E. coli* strain BW25113 cells with a fluorescence of from 0.5 to 4 times the fluorescence produced in *E. coli* strain BW25113 cells using a second EOU comprising a P10 promoter (SEQ ID NO: 1) combined with a BCD14 TIS (SEQ ID NO: 2), wherein the EOUs differ only in their promoter and TIS combinations, wherein each EOU comprises (in 5' to 3' direction) an upstream initiator, the respective promoter, the respective TIS, a nucleotide sequence encoding GFP, a 3' UTR, a transcription terminator and a downstream insulator.
6. The vector of any preceding claim, wherein the vector is devoid of a Cas adaption module; and/or wherein the vector is devoid of nucleotide sequence encoding one, more or all of a Cas1, Cas2, Cas4, Cas6, Cas7 and Cas 8.

7. The vector of any preceding claim, wherein the vector is a high copy number vector.
8. The vector of any preceding claim, wherein
 - (a) the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas11, Cas7 and Cas8a1;
 - (b) the vector comprises nucleotide sequence encoding Cas3' and/or Cas3''; and
 - (c) the nucleotide sequences encoding the Cas3' and/or Cas3'' are between the promoter and the sequence(s) recited in (a); and
 - (d) optionally the host cell comprises an endogenous Type IB, C, U, D, E or F CRISPR/Cas system.
9. The vector of any one of claims 1 to 7, wherein
 - (a) the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8b1, Cas7 and Cas5; and
 - (b) the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in (a); and
 - (c) optionally the host cell comprises an endogenous Type IA, C, U, D, E or F CRISPR/Cas system.
10. The vector of any one of claims 1 to 7, wherein
 - (a) the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas5, Cas8c and Cas7; and
 - (b) the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in (a); and
 - (c) optionally the host cell comprises an endogenous Type IA, B, U, D, E or F CRISPR/Cas system.
11. The vector of any one of claims 1 to 7, wherein
 - (a) the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8U2, Cas7, Cas5 and Cas6; and
 - (b) the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in (a); and
 - (c) optionally the host cell comprises an endogenous Type IA, B, C, D, E or F CRISPR/Cas system.
12. The vector of any one of claims 1 to 7, wherein

- (a) the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas10d, Cas7 and Cas5;
- (b) the vector comprises a nucleotide sequence encoding Cas3' and/or Cas3''; and
- (c) the nucleotide sequences encoding the Cas3' and/or Cas3'' are between the promoter and the sequence(s) recited in (a); and
- (d) optionally the host cell comprises an endogenous Type IA, B, C, U, E or F CRISPR/Cas system.

13. The vector of any one of claims 1 to 7, wherein

- (a) the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8e, Cas11, Cas7, Cas5 and Cas6; and
- (b) the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in (a); and
- (c) optionally the host cell comprises an endogenous Type IA, B, C, D, U or F CRISPR/Cas system.

14. The vector of any one of claims 1 to 7, wherein

- (a) the vector comprises (optionally in 5' to 3' direction) nucleotide sequence encoding one, more or all of Cas8f, Cas5, Cas7 and Cas6f;
- (b) the vector comprises a nucleotide sequence encoding Cas3 between the promoter and the sequence(s) recited in (a); and
- (c) the vector is devoid of nucleotide sequence encoding further Cas between the promoter and the sequence encoding the Cas3; and
- (d) optionally the host cell comprises an endogenous Type IA, B, C, D, U or E CRISPR/Cas system.

15. The vector of any one of claims 1 to 7, wherein the Cas and Cascade are

- (a) Type IB Cas and Cascade proteins; or
- (b) Type IE Cas and Cascade proteins.

16. The vector of any preceding claim, wherein the Cas3 is a Cas3 of a CRISPR/Cas locus of a first bacterial or archaeal species, wherein the distance between the Cas3-encoding sequence of the locus and its cognate promoter is further than the distance between the Cas3-encoding sequence and the respective promoter comprised by the vector; or the vector of any preceding claim, wherein the distance between the promoter and the Cas3-encoding sequence and/or Cascade protein-encoding sequence(s) is shorter than in a corresponding wild-type Type I locus.

17. The vector of any one of claims 1 to 7, wherein the Cas and Cascade are *E coli* Cas and Cascade proteins; or *Clostridium* (eg, *C difficile*) Cas and Cascade proteins.
18. The vector of any preceding claim, wherein the vector comprises (i) a CRISPR array for producing crRNAs in the host cell and/or (ii) one or more nucleotide sequences encoding one or more guide RNAs (gRNAs or single gRNAs), wherein the crRNAs or gRNAs are cognate to the Cas3 (and optionally cognate to the Cascade proteins).
19. The vector of claim 18 when dependent from claim 2, wherein the array or gRNA-encoding sequence(s) are comprised by the operon and under the control of the promoter; or wherein the array or gRNA-encoding sequence(s) are under the control of a promoter that is different from the promoter that controls the expression of the Cas3.
20. A delivery vehicle comprising the vector of any preceding claim, wherein the delivery vehicle is capable of delivering the vector into the host cell; optionally wherein the delivery vehicle is a phage, non-replicative transduction particle, nanoparticle carrier, bacterium or liposome.
21. The vector or vehicle of any preceding claim, wherein the host cell is a bacterial or archaeal cell (optionally, the host cell is a *C difficile*, *P aeruginosa*, *K pneumoniae* (eg, carbapenem-resistant *Klebsiella pneumoniae* or Extended-Spectrum Beta-Lactamase (ESBL)-producing *K pneumoniae*), *E coli* (eg, ESBL-producing *E. coli*, or *E. coli* ST131-O25b:H4), *H pylori*, *S pneumoniae* or *S aureus* cell); or the cell is a eukaryotic cell (optionally a human cell, an animal cell, a plant cell or a yeast cell).
22. The vector or vehicle of any preceding claim for administration to a human or animal subject for treating or reducing the risk of a disease or condition in the subject; optionally wherein the disease or condition is an infection of the subject with host cells (eg, bacterial cells), or wherein the disease or condition is mediated by host cells (eg, bacterial cells).
23. A pharmaceutical composition comprising the vector or vehicle of any preceding claim and a pharmaceutically acceptable diluent, excipient or carrier.