SUMMARY

In one aspect, the present disclosure refers to a mutant strain of *Clostridium acetobutylicum* expressing *dhaB1*, *dhaB2* and *dhaT* genes from *C. butyricum* and comprising attenuated glycerol kinase activity, as compared to a non-mutated strain, said glycerol kinase being encoded by the gene *glpK* at locus CA C1321 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437 of SEQ ID NO: 2, which comprise at least one of the following mutations:

a. Mutation of the codon at nucleotide positions 1462461 to 1462463 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437, for having amino acid alanine in position 347 to be replaced with threonine,
b. Mutation of the codon at nucleotide positions 1461486 to 1461488 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437, for having amino acid histidine in position 22 to be replaced with tyrosine,
c. c. Mutation of the codon at nucleotide positions 1462818 to 1462820 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437, for having amino acid valine in position 466 to be replaced by methionine.

In another aspect, the present disclosure refers to a consortium of *Clostridium* comprising the mutant strain as described herein.

In yet another aspect, the present disclosure refers to a method for the production of 1,3-propanediol and butyric acid comprising culturing the mutant strain or a consortium as defined herein, in an appropriate culture medium comprising at least glycerol and recovering the 1,3-propanediol and/or the butyric acid produced from the culture medium.

CLAIMS

1. A mutant strain of *Clostridium acetobutylicum* expressing *dhaB1*, *dhaB2* and *dhaT* genes from *C. butyricum* and comprising attenuated glycerol kinase activity, as compared to a non-mutated strain, said glycerol kinase being encoded by the gene *glpK* at locus CA_C1321 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437 of SEQ ID NO: 2, which comprise at least one of the following mutations:
    a. Mutation of the codon at nucleotide positions 1462461 to 1462463 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437, for having amino acid alanine in position 347 to be replaced with threonine,
    b. Mutation of the codon at nucleotide positions 1461486 to 1461488 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437, for having amino acid histidine in position 22 to be replaced with tyrosine,
    c. Mutation of the codon at nucleotide positions 1462818 to 1462820 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437, for having amino acid valine in position 466 to be replaced by methionine.

~~2. The mutant strain according to claim 1, wherein said glycerol kinase is encoded by the gene *glpK* at locus CA_C1321 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437.~~

~~3. The mutant strain according to claim 2 comprising at least one of the following mutations in the gene *glpK* at locus CA_C1321:~~
    ~~a. Mutation of the codon at nucleotide positions 1462461 to 1462463 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437, for having amino acid alanine in position 347 to be replaced with threonine,~~
    ~~b. Mutation of the codon at nucleotide positions 1461486 to 1461488 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437, for having amino acid histidine in position 22 to be replaced with tyrosine,~~
    ~~c. Mutation of the codon at nucleotide positions 1462818 to 1462820 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437, for having amino acid valine in position 466 to be replaced by methionine.~~

~~4.~~2. The mutant strain according to claim 1~~3~~, comprising at least at locus CA_C1321, the mutation of the codon at nucleotide positions 1462461 to 1462463 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437, for having amino acid alanine in position 347 to be replaced with threonine.

~~5.~~3. The mutant strain according to anyone of the preceding claims, further comprising attenuated hydrogen dehydrogenase activity, as compared to a non-mutated strain, preferably inactivated hydrogen dehydrogenase activity.

~~6.~~4. The mutant strain according to claim ~~3~~5, wherein said hydrogen dehydrogenase is of SEQ ID NO: 15, encoded by the gene *hydA* at locus CA_C0028 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437.

~~7.~~5. The mutant strain according to claim ~~4~~6 comprising at least deletion of the nucleotide C at the nucleotide position 39233 in the gene *hydA* at locus CA_C0028 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437, leading to the mutated gene of SEQ ID NO: 18.

~~8.~~6. The mutant strain according to anyone of the preceding claims, further comprising enhanced glycerol uptake facilitator permease activity, as compared to a non-mutated strain.

~~9.~~7. The mutant strain according to claim ~~6~~8, wherein said glycerol uptake facilitator protein is of SEQ ID NO: 19, encoded by the gene *glpF* at locus CA_C0770 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437.

~~10.~~8. The mutant strain according to claim ~~7~~9 comprising at least replacement of the nucleotide G at the nucleotide position 892875 in the gene *glpF* at locus CA_C0770 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437, leading to the mutated gene of SEQ ID NO: 22.

~~11.~~9. The mutant strain according to anyone of the preceding claims, further comprising attenuated electron transfer flavoprotein subunit alpha activity, as compared to a non-mutated strain.

~~12.~~10. The mutant strain according to claim ~~9~~11, wherein said electron transfer flavoprotein subunit alpha is of SEQ ID NO: 23, encoded by the gene *etfA* at locus CA_C2709 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437.

~~13.~~11. The mutant strain according to claim ~~10~~12 comprising at least replacement of the nucleotide T at the nucleotide position 2833384 in the gene *etfA* at locus

CA_C2709 in the *C. acetobutylicum* genome ATCC824, Genbank AE001437, leading to the mutated gene of SEQ ID NO: 26.

~~14.~~12. A consortium of *Clostridium* comprising the mutant strain according to anyone of claims 1 to 11~~13~~.

~~15.~~13. The consortium of *Clostridium* according to claim 12~~14~~ comprising the mutant strain *Clostridium acetobutylicum* as defined in anyone of claims 1 to 11~~13~~ and at least one strain of *Clostridium sporogenes* and/or at least one strain of *Clostridium sphenoides*.

~~16.~~14. A method for the production of 1,3-propanediol and butyric acid comprising culturing the mutant strain as defined in anyone of claims 1 to 11~~13~~ or a consortium as defined in claims 12 or 13~~14~~, in an appropriate culture medium comprising at least glycerol and recovering the 1,3-propanediol and/or the butyric acid produced from the culture medium.

~~17.~~15. The method for the production of 1,3-propanediol and butyric acid according to claim 14~~16~~, wherein 1,3-propanediol and/or butyric acid produced is further purified.

~~18.~~16. The method for the production of 1,3-propanediol and butyric acid according to anyone of claims 14~~16~~ to 15~~17~~, wherein glycerol concentration in the culture medium is from 90 to 120 g/L, preferably about 105 g/L.

~~19.~~17. The method for the production of 1,3-propanediol and butyric acid according to anyone of claims 14~~16~~ to 16~~18~~, wherein the culture medium is exempt of organic nitrogen, and preferably is a synthetic medium without addition of organic nitrogen, more preferably without yeast extract.