Claims

1. A polynucleotide encoding

   a) severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) spike protein; and

   b) at least one non-structural SARS-CoV-2 protein selected from the group consisting of non-structural protein 7, non-structural protein 8, non-structural protein 9, non-structural protein 10, non-structural protein 11, non-structural protein 12, an endoribonuclease, and a 2'-O-methyltransferase,

   wherein the polynucleotide comprises at least one sequence part comprising codon-pair deoptimizations in comparison to the SARS-CoV-2 genome having the gene bank accession number MT108784.1,

   wherein the polynucleotide further comprises a furin cleavage site modification, wherein the furin cleavage site modification results in a loss of a furin cleavage site being naturally present in the SARS-CoV-2 genome having the gene bank accession number MT108784.1,

   wherein the polynucleotide comprises a nucleic acid sequence as defined by SEQ ID NO. 8 or SEQ ID NO. 16 or a nucleic acid sequence having at least 95 % sequence identity to SEQ ID NO. 8 or SEQ ID NO. 16.

2. The polynucleotide of claim 1, wherein the furin cleavage site modification is an at least partial deletion of a furin cleavage site being naturally present in the SARS-CoV-2 genome.

3. The polynucleotide of any one of claims 1 or 2, wherein the furin cleavage site modification comprises a deletion of the nucleotides encoding an amino acid sequence XRRA, wherein X denotes P, R or H.

4. The polynucleotide of any one of the preceding claims, wherein the furin cleavage site modification effects that an expression of the polynucleotide results in a protein in which at least 5 consecutive amino acids of the naturally expressed protein are replaced by a single amino acid.

5. The polynucleotide of any one of the preceding claims, wherein the furin cleavage site modification consists of or comprises a deletion of a nucleic acid sequence as defined by SEQ ID NO. 18 or a nucleic acid sequence having at least 95 % sequence identity to SEQ ID NO. 18.

6. A live attenuated severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) comprising the polynucleotide according to any one of claims 1 to 5.

7. The live attenuated SARS-CoV-2 according to claim 6, wherein the SARS-CoV-2 has a nucleic acid sequence as defined by SEQ ID NO. 19 or a nucleic acid sequence having at least 98 % sequence identity to SEQ ID NO. 19.

8. A pharmaceutical composition comprising the live attenuated SARS-CoV-2 according to any one of claims 6 to 7.

9. Pharmaceutical composition according to claim 8 for use as vaccine.

10. A vector comprising the polynucleotide according to any one of claims 1 to 5.

11. A host cell comprising the polynucleotide according to any one of claims 1 to 5.

12. A method for production of a virus, the method comprising the steps of:

    a) culturing a host cell according to claim 11; and

    b) isolating a virus, wherein the virus is a live attenuated SARS-CoV-2.

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