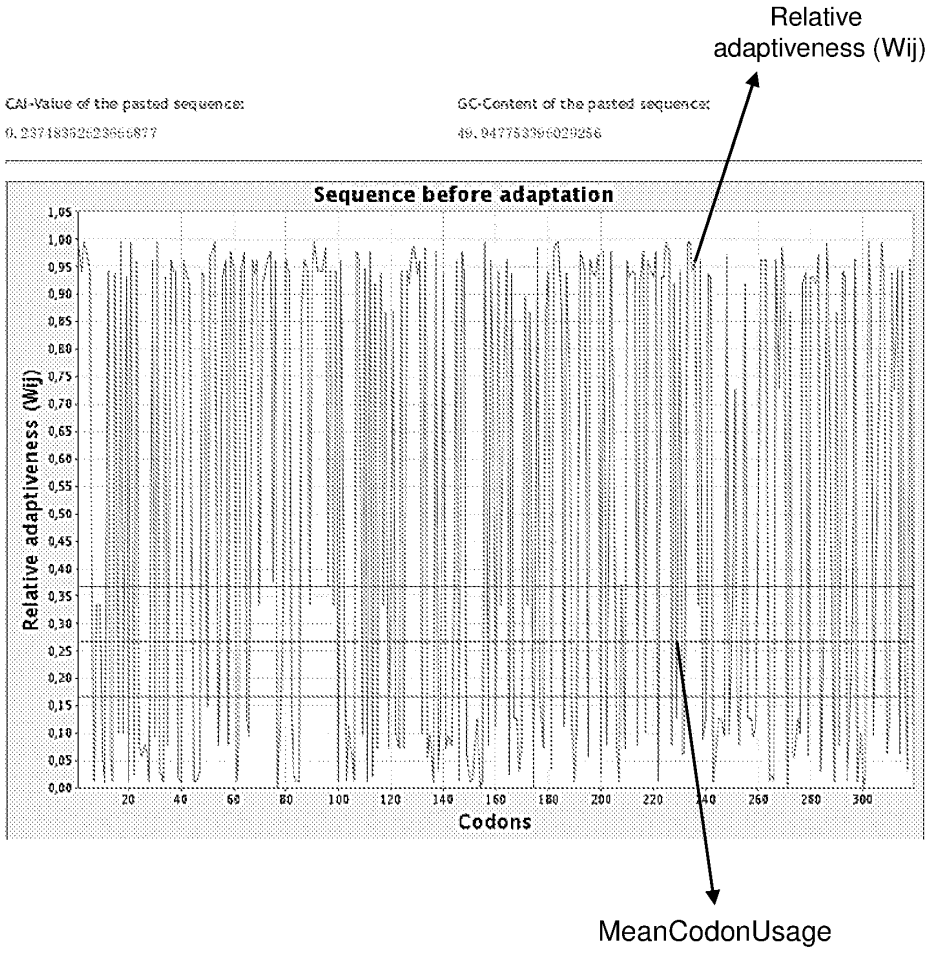

Relative adaptiveness (Wij)
CAI-Value of the pasted sequence:
GC-Content of the pasted sequence:
Sequence before adaptation
Relative adaptiveness (Wij)
Codons
MeanCodonUsage

FIG. 1

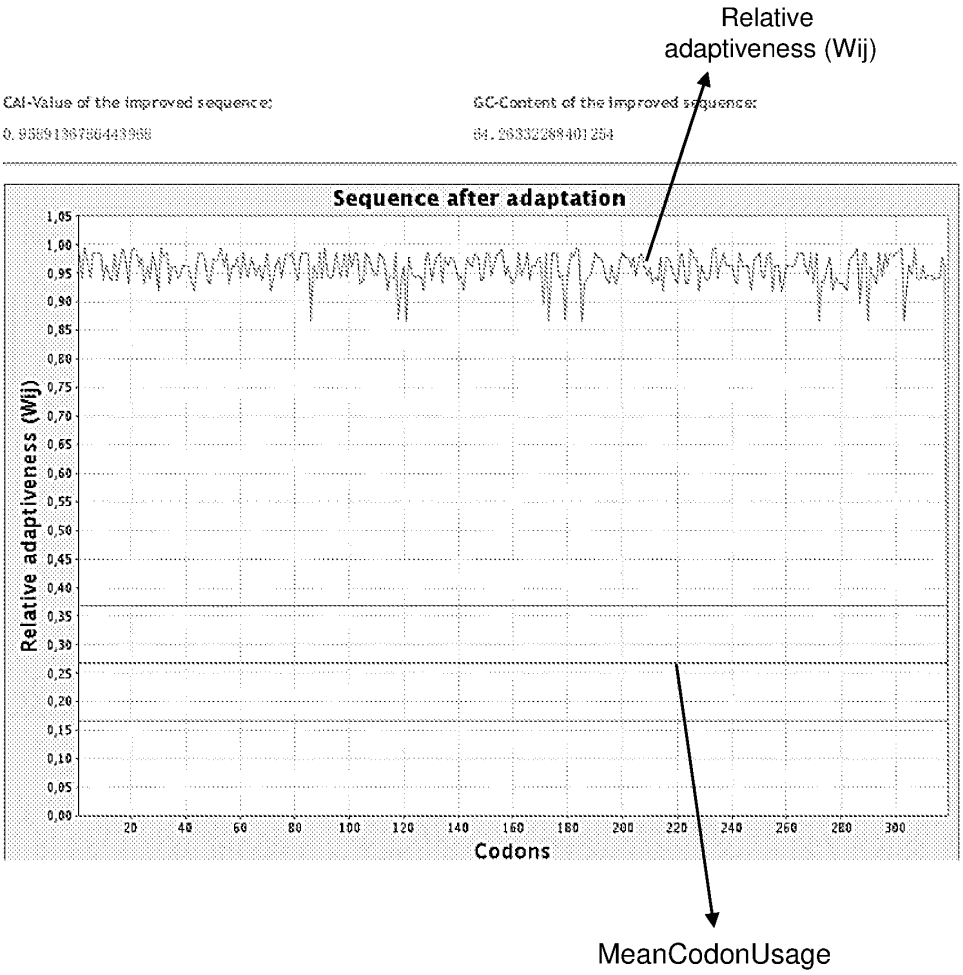

Relative adaptiveness (Wij)
CAI-Value of the improved sequence:
0.9589136780443968
GC-Content of the improved sequence:
64.26332288401254
Sequence after adaptation
Relative adaptiveness (Wij)
1,05
1,00
0,95
0,90
0,85
0,80
0,75
0,70
0,65
0,60
0,55
0,50
0,45
0,40
0,35
0,30
0,25
0,20
0,15
0,10
0,05
0,00
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Codons
MeanCodonUsage

FIG. 2

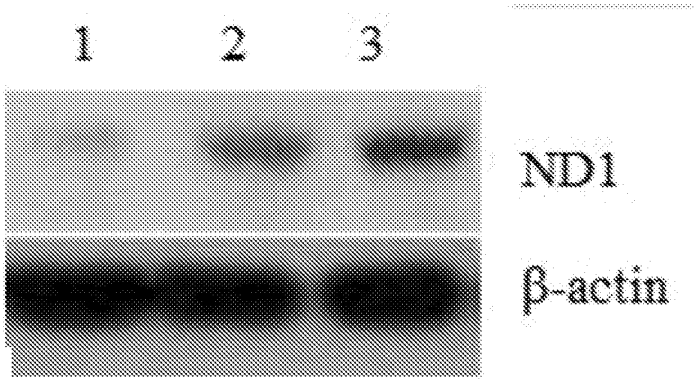
```
Sequence Alignment of Opt_ND1 (upper line) and ND1(lower line)
Identity=79.00%(756/957)  Gap=0.00%(0/957)
-----------------
1     ATGCCCATGGCCAACCTGCTGCTGCTGATCGTGCCCATCCTGATCGCCATGGCCTTCCTG
      |||||||||||||||| || || || || || ||||| || ||||| ||||| |||||
1     ATGCCCATGGCCAACCTCCTACTCCTCATTGTACCCATTCTAATCGCAATGGCATTCCTA
61    ATGCTGACCGAGCGCAAGATCCTGGGCTACATGCAGCTGCGCAAGGGCCCCAACGTGGTG
      ||||| ||||| || || || || ||||| ||||| || ||||| ||||||||||| ||
61    ATGCTTACCGAACGAAAAATTCTAGGCTATATGCAACTACGCAAAGGCCCCAACGTTGTA
121   GGCCCCTACGGCCTGCTGCAGCCCTTCGCCGACGCCATGAAGCTGTTCACCAAGGAGCCC
      |||||||||| || || || |||||||| |||||||||| || |||||||| ||||||
121   GGCCCCTACGGGCTACTACAACCCTTCGCTGACGCCATGAAACTCTTCACCAAAGAGCCC
181   CTGAAGCCCGCCACCAGCACCATCACCCTGTACATCACCGCCCCCACCCTGGCCCTGACC
      || || ||||||||    |||||||||| |||||||||||||| ||| | || || |||
181   CTAAAACCCGCCACATCTACCATCACCCTCTACATCACCGCCCCGACCTTAGCTCTCACC
241   ATCGCCCTGCTGCTGTGGACCCCCCTGCCCATGCCCAACCCCCTGGTGAACCTGAACCTG
      ||||| || || || |||||||||| |||||||||||||||||||| ||||| |||||
241   ATCGCTCTTCTACTATGGACCCCCCTCCCCATGCCCAACCCCCTGGTCAACCTCAACCTA
301   GGCCTGCTGTTCATCCTGGCCACCAGCAGCCTGGCCGTGTACAGCATCCTGTGGAGCGGC
      ||||| || || || ||||||   ||||| ||||| |||   ||||| |||   ||
301   GGCCTCCTATTTATTCTAGCCACCTCTAGCCTAGCCGTTTACTCAATCCTCTGGTCAGGG
361   TGGGCCAGCAACAGCAACTACGCCCTGATCGGCGCCCTGCGCGCCGTGGCCCAGACCATC
      |||||    |||   |||||||||||||||||||| ||||| || || ||||| || |||
361   TGGGCATCAAACTCAAACTACGCCCTGATCGGCGCACTGCGAGCAGTAGCCCAAACAATC
421   AGCTACGAGGTGACCCTGGCCATCATCCTGCTGAGCACCCTGCTGATGAGCGGCAGCTTC
         || || || ||||| |||||||| || ||    ||  | || ||||| |||  |||
421   TCATATGAAGTCACCCTAGCCATCATTCTACTATCAACATTACTAATGAGTGGCTCCTTT

481   AACCTGAGCACCCTGATCACCACCCAGGAGCACCTGTGGCTGCTGCTGCCCAGCTGGCCC
      |||||   |||||| ||||| || || || ||||| ||| | || |||||    ||||||
481   AACCTCTCCACCCTTATCACAACACAAGAACACCTCTGGTTACTCCTGCCATCATGGCCC
541   CTGGCCATGATGTGGTTCATCAGCACCCTGGCCGAGACCAACCGCACCCCCTTCGACCTG
       |||||||||||||||| |||  ||| || || |||||||||| ||||||||||||||
541   TTGGCCATGATGTGGTTTATCTCCACACTAGCAGAGACCAACCGAACCCCCTTCGACCTT
601   GCCGAGGGCGAGAGCGAGCTGGTGAGCGGCTTCAACATCGAGTACGCCGCCGGCCCCTTC
      ||||| || |||  ||| || ||    |||||||||||||| |||||||| |||||||||
601   GCCGAAGGGGAGTCCGAACTAGTCTCAGGCTTCAACATCGAATACGCCGCAGGCCCCTTC
661   GCCCTGTTCTTCATGGCCGAGTACACCAACATCATCATGATGAACACCCTGACCACCACC
      ||||| |||||||||||||| ||||| ||||| || |||||||||||||| ||||| ||
661   GCCCTATTCTTCATGGCCGAATACACAAACATTATTATGATGAACACCCTCACCACTACA
721   ATCTTCCTGGGCACCACCTACGACGCCCTGAGCCCCGAGCTGTACACCACCTACTTCGTG
      |||||||| || || || || ||||| ||   ||| || || ||||| || || || ||
721   ATCTTCCTAGGAACAACATATGACGCACTCTCCCCTGAACTCTACACAACATATTTTGTC
781   ACCAAGACCCTGCTGCTGACCAGCCTGTTCCTGTGGATCCGCACCGCCTACCCCCGCTTC
      |||||||||| || || |||  ||||||| | ||||| || || || |||||||| |||
781   ACCAAGACCCTACTTCTAACCTCCCTGTTCTTATGGATTCGAACAGCATACCCCCGATTC
841   CGCTACGACCAGCTGATGCACCTGCTGTGGAAGAACTTCCTGCCCCTGACCCTGGCCCTG
      |||||||||| || |||||||| || ||||| |||||||| || || ||||| ||  |
841   CGCTACGACCAACTCATGCACCTCCTATGGAAAAACTTCCTACCACTCACCCTAGCATTA
901   CTGATGTGGTACGTGAGCATGCCCATCACCATCAGCAGCATCCCCCCCCCAGACCTAA
      || |||||||| ||   ||||||||| || |||  |||||| ||||| || ||||||
901   CTTATGTGGTATGTCTCCATGCCCATTACAATCTCCAGCATTCCCCCTCAAACCTAA
```

FIG. 3

Sequence Alignment of COX10-opt_ND1 (upper line) and COX10-ND1 (lower line)
Identity=81% (840/1041) Gap=0.00%(0/1041)

```
1     ATGGCCGCATCTCCGCACACTCTCTCCTCACGCCTCCTGACAGGTTGCGTAGGAGGCTCT
      ||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||
1     ATGGCCGCATCTCCGCACACTCTCTCCTCACGCCTCCTGACAGGTTGCGTAGGAGGCTCT

61    GTCTGGTATCTTGAAAGAAGAACTATGCCCATGGCCAACCTGCTGCTGCTGATCGTGCCC
      |||||||||||||||||||||||||||||||||||||||||  ||  ||  ||  ||  |||
61    GTCTGGTATCTTGAAAGAAGAACTATGCCCATGGCCAACCTCCTACTCCTCATTGTACCC

121   ATCCTGATCGCCATGGCCTTCCTGATGCTGACCGAGCGCAAGATCCTGGGCTACATGCAG
      ||  ||  |||||  |||||  |||||  |||||  |||||  ||  ||  ||  ||  |||||  |||||
121   ATTCTAATCGCAATGGCATTCCTAATGCTTACCGAACGAAAAATTCTAGGCTATATGCAA

181   CTGCGCAAGGGCCCCAACGTGGTGGGCCCCTACGGCCTGCTGCAGCCCTTCGCCGACGCC
      ||  |||||  ||||||||||||  ||  ||||||||||||  ||  ||  ||  ||||||||  |||||||
181   CTACGCAAAGGCCCCAACGTTGTAGGCCCCTACGGGCTACTACAACCCTTCGCTGACGCC

241   ATGAAGCTGTTCACCAAGGAGCCCCTGAAGCCCGCCACCAGCACCATCACCCTGTACATC
      ||||||  ||  |||||||||  |||||||||  ||  |||||||||     ||||||||||||  |||||||
241   ATGAAACTCTTCACCAAAGAGCCCCTAAAACCCGCCACATCTACCATCACCCTCTACATC

301   ACCGCCCCCCACCCTGGCCCTGACCATCGCCCTGCTGCTGTGGACCCCCCCTGCCCATGCCC
      ||||||||  |||  |  ||  ||  |||||||||  ||  ||  ||  ||||||||||  |||||||||
301   ACCGCCCCCGACCTTAGCTCTCACCATCGCTCTTCTACTATGGACCCCCCTCCCCATGCCC

361   AACCCCCTGGTGAACCTGAACCTGGGCCTGCTGTTCATCCTGGCCACCAGCAGCCTGGCC
      ||||||||||  |||||  |||||  |||||  ||  ||  ||  ||  ||||||     |||||  |||
361   AACCCCCTGGTCAACCTCAACCTAGGCCTCCTATTTATTCTAGCCACCTCTAGCCTAGCC

421   GTGTACAGCATCCTGTGGAGCGGCTGGGCCAGCAACAGCAACTACGCCCTGATCGGCGCC
      ||  |||    |||||  |||    ||  |||||     |||    ||||||||||||||||||||
421   GTTTACTCAATCCTCTGGTCAGGGTGGGCATCAAACTCAAACTACGCCCTGATCGGCGCA

481   CTGCGCGCCCGTGGCCCAGACCATCAGCTACGAGGTGACCCTGGCCATCATCCTGCTGAGC
      |||||  ||  ||  |||||  ||  |||    ||  ||  ||  |||||  |||||||||  ||  ||
481   CTGCGAGCAGTAGCCCAAACAATCTCATATGAAGTCACCCTAGCCATCATTCTACTATCA

541   ACCCTGCTGATGAGCGGCAGCTTCAACCTGAGCACCCTGATCACCACCCAGGAGCACCTG
      ||  |  ||  |||||  |||  |||  |||||  |||||  |||||  ||  ||  |||||
541   ACATTACTAATGAGTGGCTCCTTTAACCTCTCCACCCTTATCACAACACAAGAACACCTC

601   TGGCTGCTGCTGCCCAGCTGGCCCCTGGCCATGATGTGGTTCATCAGCACCCTGGCCGAG
      |||  |  ||  |||||      |||||||  ||||||||||||||||  |||  |||  ||  ||  |||
601   TGGTTACTCCTGCCATCATGGCCCTTGGCCATGATGTGGTTTATCTCCACACTAGCAGAG

661   ACCAACCGCACCCCCCTTCGACCTGGCCGAGGGCGAGAGCGAGCTGGTGAGCGGCTTCAAC
      ||||||||  ||||||||||||||  |||||  ||  |||  |||  ||  ||      |||||||||
661   ACCAACCGAACCCCCTTCGACCTTGCCGAAGGGGAGTCCGAACTAGTCTCAGGCTTCAAC

721   ATCGAGTACGCCGCCGGCCCCTTCGCCCTGTTCTTCATGGCCGAGTACACCAACATCATC
      ||||||  |||||||||  ||||||||||||||||  ||||||||||||||  |||||  |||||  ||
721   ATCGAATACGCCGCAGGCCCCTTCGCCCTATTCTTCATGGCCGAATACACAAACATTATT

781   ATGATGAACACCCTGACCACCACCATCTTCCTGGGCACCACCTACGACGCCCTGAGCCCC
      ||||||||||||||  |||||  ||  |||||||||  ||  ||  ||  ||  |||||  ||     |||
781   ATGATGAACACCCTCACCACTACAATCTTCCTAGGAACAACATATGACGCACTCTCCCCT

841   GAGCTGTACACCACCTACTTCGTGACCAAGACCCTGCTGCTGACCAGCCTGTTCCTGTGG
      ||  ||  |||||  ||  ||  ||  ||  ||||||||||||  ||  ||  |||  ||||||||  |  |||
841   GAACTCTACACAACATATTTTGTCACCAAGACCCTACTTCTAACCTCCCTGTTCTTATGG

901   ATCCGCACCGCCTACCCCCGCTTCCGCTACGACCAGCTGATGCACCTGCTGTGGAAGAAC
      ||  ||  ||  ||  |||||||||  ||||||||||||||  ||  |||||||||  ||  |||||  |||
901   ATTCGAACAGCATACCCCCGATTCCGCTACGACCAACTCATGCACCTCCTATGGAAAAAC

961   TTCCTGCCCCTGACCCTGGCCCTGCTGATGTGGTACGTGAGCATGCCCATCACCATCAGC
      |||||  ||  ||  |||||  ||  |  ||  |||||||||  ||    |||||||||  ||  |||  |
961   TTCCTACCACTCACCCTAGCATTACTTATGTGGTATGTCTCCATGCCCATTACAATCTCC

1021  AGCATCCCCCCCCAGACCTAA
      |||||  |||||  ||  ||||||
1021  AGCATTCCCCCTCAAACCTAA
```

FIG. 4


1
2
3
ND1
β-actin

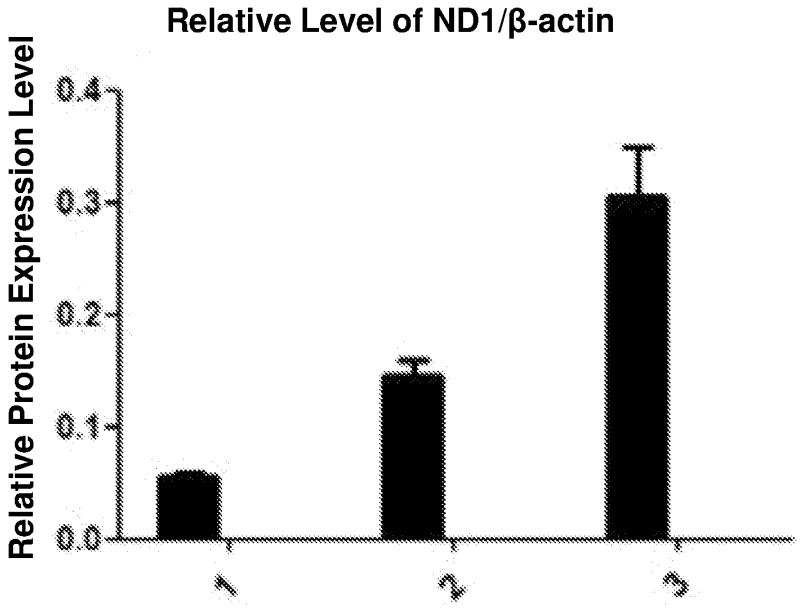
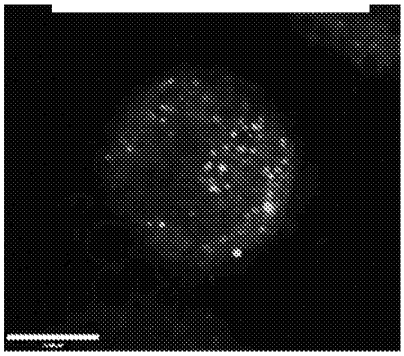
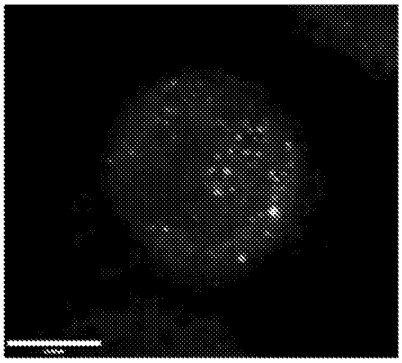

Relative Level of ND1/β-actin
Relative Protein Expression Level
0.4
0.3
0.2
0.1
0.0

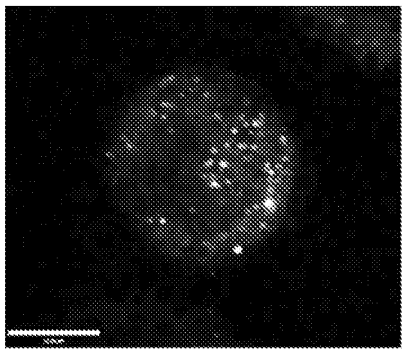
FIG. 5



ND1-GFP



MitoTracker



Merged

FIG. 6

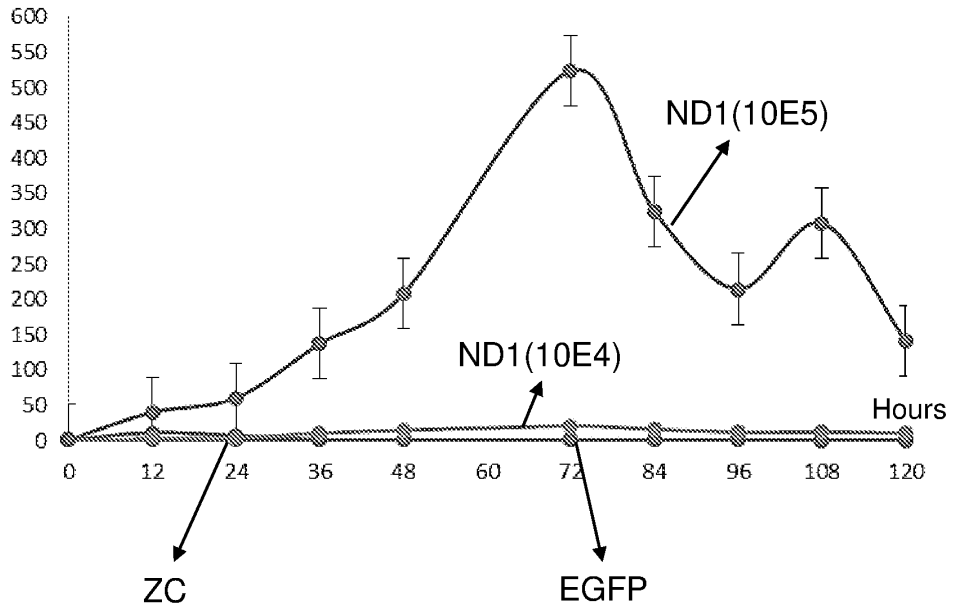

600
550
500
450
400
350
300
250
200
150
100
50
0
0
12
24
36
48
60
72
84
96
108
120
ND1(10E5)
ND1(10E4)
Hours
ZC
EGFP

FIG. 7

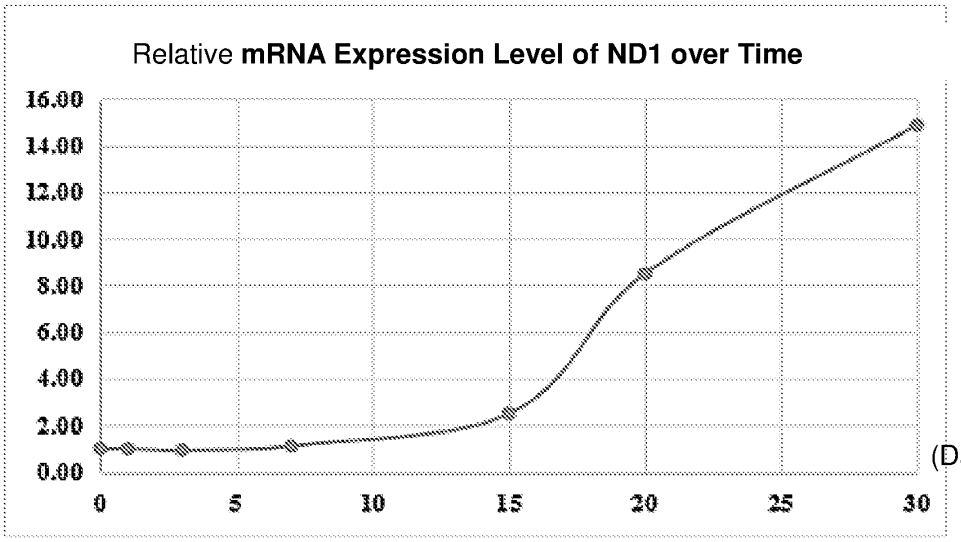

Relative mRNA Expression Level of ND1 over Time
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0
5
10
15
20
25
30
(Days)

FIG. 8

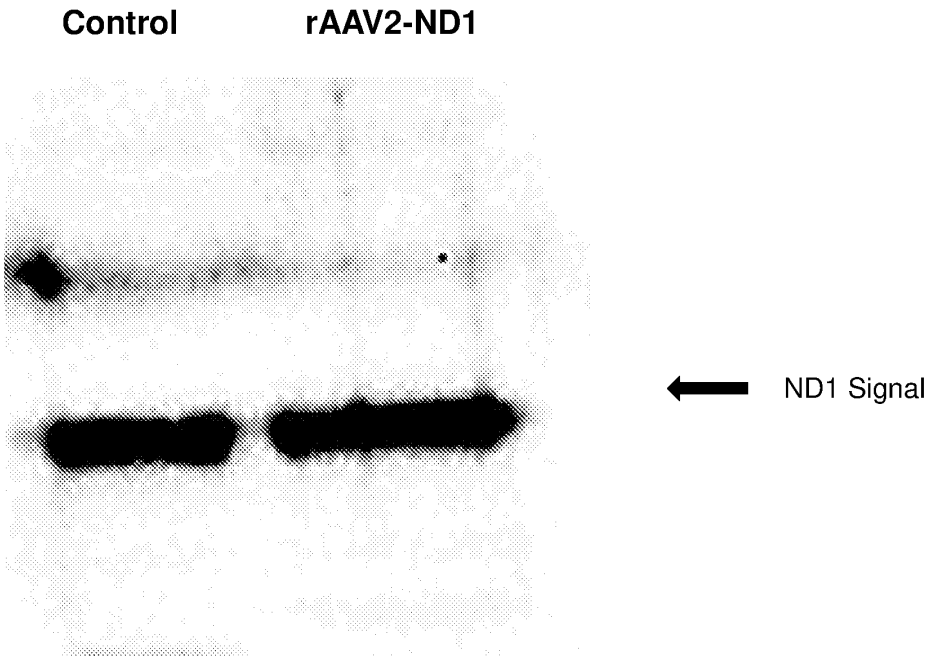
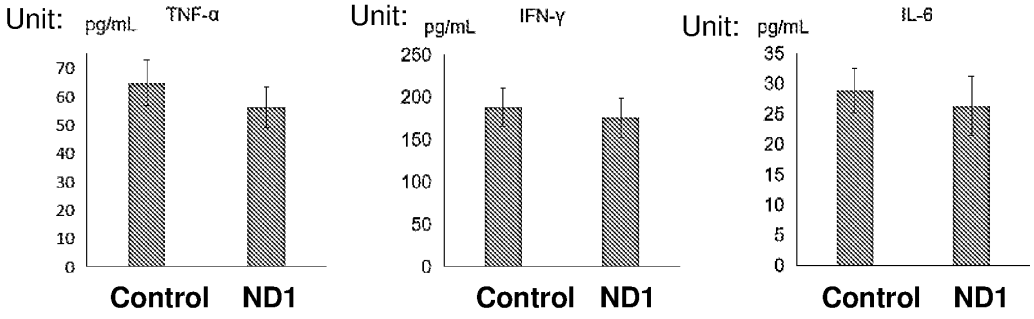
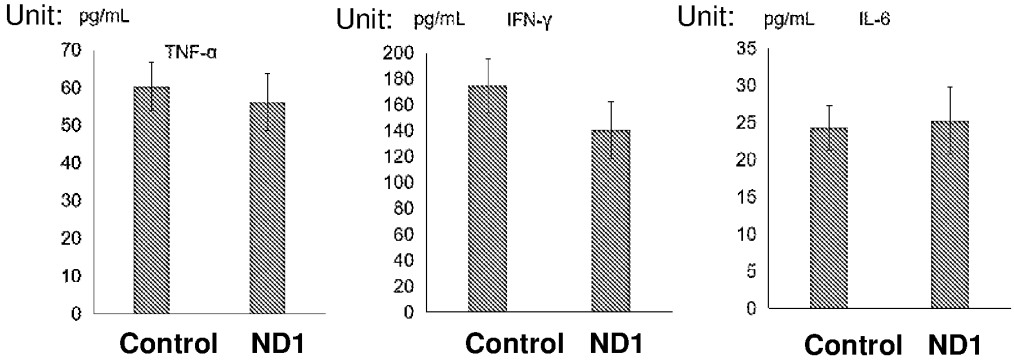


FIG. 9



1-month post-injection



2-month post-injection

FIG. 10