Supplementary Material

# Supplementary Table 1. Processed amino acid sequence dataset size of each ORF region

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **ORF1a** | **ORF1b** | **S** | **ORF3a** | **E** | **M** |
| 16863 | 14252 | 16851 | 23390 | 24344 | 23513 |
| **ORF6** | **ORF7a** | **ORF7b** | **ORF8** | **N** | **ORF10** |
| 24199 | 21690 | 21953 | 24288 | 23176 | 24043 |

# Supplementary Table 2. Sense mutation sites in ORF region

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Gene | Location | Base Changes (%) | AA Changes (%) |
| 1 | ORF1a | 490 | T:A:C= 98.97%:1.03%:0.01% | Asp:Glu:Gly:Asn = 98.96%:1.03%:0.01%:0.01% |
| 2 | ORF1a | 1059 | C:T:A = 79.42%:20.55%:0.02% | Thr:Ile:Asn = 79.42%:20.55%:0.02% |
| 3 | ORF1a | 1440 | G:A = 98.39%:1.61% | Gly:Asp:Cys = 98.38%:1.61%:0.02% |
| 4 | ORF1a | 1609 | C:-:T = 97.06%:2.9%:0.04% | Asp:- = 97.1%:2.9% |
| 5 | ORF1a | 2480 | A:G = 95.88%:4.12% | Ile:Val = 95.88%:4.12% |
| 6 | ORF1a | 2558 | C:T = 95.67%:4.33% | Pro:Ser:Leu = 95.67%:4.32%:0.01% |
| 7 | ORF1a | 2891 | G:A:T = 98.4%:1.6%:0.01% | Ala:Thr:Ser = 98.4%:1.6%:0.01% |
| 8 | ORF1a | 3177 | C:T:A = 98.91%:1.06%:0.04% | Pro:Leu:Gln:Ser:Ile:His = 98.89%:1.05%:0.02%:0.02%:0.01%:0.01% |
| 9 | ORF1a | 4002 | C:T = 98.97%:1.03% | Thr:Ile = 98.97%:1.03% |
| 10 | ORF1a | 9477 | T:A = 98.85%:1.15% | Phe:Tyr = 98.85%:1.15% |
| 11 | ORF1a | 10097 | G:A = 98.06%:1.94% | Gly:Ser:Asp = 98.05%:1.94%:0.01% |
| 12 | ORF1a | 11083 | G:T = 88.08%:11.91% | Leu:Phe:Val = 88.07%:11.88%:0.04% |
| 13 | ORF1a | 11916 | C:T = 98.55%:1.45% | Ser:Leu = 98.55%:1.45% |
| 14 | ORF1b | 14408 | T:C = 67.31%:32.69% | Leu:Pro:Phe:Ser = 67.29%:32.68%:0.02%:0.01% |
| 15 | ORF1b | 17747 | C:T = 92.18%:7.82% | Pro:Leu:Ser = 92.16%:7.82%:0.02% |
| 16 | ORF1b | 17858 | A:G = 92.07%:7.93% | Tyr:Cys = 92.07%:7.93% |
| 17 | ORF1b | 18736 | T:C = 98.69%:1.31% | Phe:Leu = 98.69%:1.31% |
| 18 | ORF1b | 18998 | C:T = 98.8%:1.2% | Ala:Val = 98.8%:1.2% |
| 19 | S | 23403 | G:A = 67.79%:32.21% | Gly:Asp:Asn = 67.79%:32.19%:0.01% |
| 20 | ORF3a | 25429 | G:T:- = 97.13%:2.86%:0.01% | Val:Leu:- = :97.13%:2.86%:0.01% |
| 21 | ORF3a | 25563 | G:T:A:C = 77.35%:22.63%:0.01%:0.01% | Gln:His = 77.35%:22.65% |
| 22 | ORF3a | 26144 | G:T = 89.64%:10.36% | Gly:Val:Cys = 89.63%:10.36%:0.01% |
| 23 | M | 27046 | C:T = 98%:2% | Thr:Met = 98%:2% |
| 24 | ORF8 | 27964 | C:T = 98.16%:1.84% | Ser:Leu = 98.16%:1.84% |
| 25 | ORF8 | 28077 | G:C:T = 98.77%:1.03%:0.2% | Val:Leu:Ala = 98.76%:1.23%:0.01% |
| 26 | ORF8 | 28144 | T:C = 90.47%:9.53% | Leu:Ser = 90.47%:9.53% |
| 27 | N | 28311 | C:T = 98.89%:1.1% | Pro:Leu:Thr:Ser = 98.86%:1.1%:0.02%:0.01% |
| 28 | N | 28580 | G:T = 98.74%:1.26% | Asp:Tyr = 98.74%:1.26% |
| 29 | N | 28851 | G:T:C- = 98.73%:1.26%:0.01% | Ser:Ile:Thr = 98.73%:1.26%:0.01% |
| 30 | N | 28854 | C:T = 98.41%:1.59% | Ser:Leu = 98.41%:1.59% |
| 31 | N | 28863 | C:T = 98.79%:1.21% | Ser:Leu:Thr = 98.78%:1.21%:0.01% |
| 32 | N | 28881 | G:A:T = 74.82%:25.15%:0.02% | Arg:Lys:Ser:Met= 74.78%:25.15%:0.04%:0.02% |
| 33 | N | 28883 | G:C:A:- = 74.89%:25.09%:0.01%:0.01% | Gly:Arg:- = 74.89%:25.1%:0.01% |

# Supplementary Table 3. Non-sense mutation sites in ORF region

|  |  |  |  |
| --- | --- | --- | --- |
| NO | Gene | Location | Base Changes (%) |
| 1 | ORF1a | 313 | C:T = 98.84%:1.16% |
| 2 | ORF1a | 1606 | T:G:- = 97.09%:2.89%:0.01% |
| 3 | ORF1a | 1607 | G:- = 97.1%:2.9% |
| 4 | ORF1a | 1608 | A:- = 97.1%:2.9% |
| 5 | ORF1a | 2416 | C:T = 98.16%:1.84% |
| 6 | ORF1a | 3037 | T:C = 70.4%:29.6% |
| 7 | ORF1a | 8782 | C:T = 89.53%:10.47% |
| 8 | ORF1b | 14805 | C:T = 92.13%:7.87% |
| 9 | ORF1b | 15324 | C:T = 97.59%:2.41% |
| 10 | ORF1b | 17247 | T:C:G = 97.16%:2.83%:0.01% |
| 11 | ORF1b | 18060 | C:T:A = 91.9%:8.1%:0.01% |
| 12 | ORF1b | 18877 | C:T = 96.99%:3.01% |
| 13 | ORF1b | 20268 | A:G = 94.76%:5.24% |
| 14 | S | 23731 | C:T = 97.42%:2.58% |
| 15 | S | 24034 | C:T = 98.85%:1.15% |
| 16 | N | 28657 | C:T:A = 98.71%:1.26%:0.03% |
| 17 | N | 28882 | G:A:T = 74.86%:25.09%:0.04%: |

# Supplementary Table 4. ORF region amino acid lost-mutation information list

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| No. | Gene | Location | Frequency | No. | Gene | Location | Frequency |
| 1 | ORF1a | 362 : 385 | 1/16863 | 41 | S | 21965 : 21973 | 1/16851 |
| 2 | ORF1a | 512 : 517 | 2/16863 | 42 | S | 22259 : 22264 | 1/16851 |
| 3 | ORF1a | 512 : 520 | 11/16863 | 43 | S | 22259 : 22267 | 2/16851 |
| 4 | ORF1a | 512 : 526 | 6/16863 | 44 | S | 23558 : 23575 | 2/16851 |
| 5 | ORF1a | 518 : 523 | 23/16863 | 45 | S | 23570 : 23602 | 1/16851 |
| 6 | ORF1a | 518 : 526 | 16/16863 | 46 | S | 23576 : 23590 | 1/16851 |
| 7 | ORF1a | 686 : 697 | 45/16863 | 47 | ORF3a | 25417 : 25428 | 1/23390 |
| 8 | ORF1a | 1430 : 1435 | 2/16863 | 48 | ORF3a | 25423 : 25434 | 1/23390 |
| 9 | ORF1a | 1580 : 1585 | 1/16863 | 49 | ORF3a | 25429 : 25455 | 1/23390 |
| 10 | ORF1a | 1598 : 1606 | 1/16863 | 50 | ORF3a | 25495 : 25503 | 1/23390 |
| 11 | ORF1a | 1604 : 1609 | 1/16863 | 51 | ORF3a | 25519 : 25536 | 1/23390 |
| 12 | ORF1a | 1604 : 1621 | 1/16863 | 52 | ORF3a | 25621 : 25650 | 1/23390 |
| 13 | ORF1a | 1607 : 1612 | 1/16863 | 53 | ORF3a | 25711 : 25716 | 1/23390 |
| 14 | ORF1a | 3164 : 3172 | 4/16863 | 54 | ORF3a | 25921 : 25950 | 1/23390 |
| 15 | ORF1a | 3248 : 3274 | 1/16863 | 55 | ORF3a | 25993 : 25998 | 1/23390 |
| 16 | ORF1a | 3260 : 3265 | 1/16863 | 56 | ORF3a | 26158 : 26163 | 3/23390 |
| 17 | ORF1a | 3302 : 3322 | 1/16863 | 57 | ORF3a | 26188 : 26205 | 1/23390 |
| 18 | ORF1a | 3305 : 3322 | 3/16863 | 58 | E | 26347 : 26370 | 1/24344 |
| 19 | ORF1a | 3332 : 3343 | 1/16863 | 59 | E | 26359 : 26400 | 1/24344 |
| 20 | ORF1a | 3332 : 3346 | 1/16863 | 60 | E | 26413 : 26418 | 1/24344 |
| 21 | ORF1a | 3863 : 3868 | 3/16863 | 61 | M | 27057 : 27062 | 1/23513 |
| 22 | ORF1a | 3938 : 3946 | 1/16863 | 62 | ORF6 | 27268 : 27294 | 2/24199 |
| 23 | ORF1a | 4880 : 4885 | 2/16863 | 63 | ORF6 | 27274 : 27294 | 1/24199 |
| 24 | ORF1a | 5810 : 5827 | 1/16863 | 64 | ORF6 | 27298 : 27303 | 1/24199 |
| 25 | ORF1a | 6044 : 6049 | 1/16863 | 65 | ORF7a | 27406 : 27489 | 1/21690 |
| 26 | ORF1a | 6374 : 6385 | 1/16863 | 66 | ORF7a | 27586 : 27594 | 1/21690 |
| 27 | ORF1a | 6518 : 6526 | 2/16863 | 67 | ORF7a | 27682 : 27708 | 1/21690 |
| 28 | ORF1a | 6854 : 6862 | 1/16863 | 68 | ORF7a | 27700 : 27705 | 1/21690 |
| 29 | ORF1a | 9722 : 9739 | 1/16863 | 69 | ORF7b | 27768 : 27773 | 3/21953 |
| 30 | ORF1a | 11270 : 11278 | 1/16863 | 70 | ORF7b | 27792 : 27797 | 2/21953 |
| 31 | ORF1a | 11270 : 11281 | 2/16863 | 71 | ORF8 | 28092 : 28097 | 6/24288 |
| 32 | ORF1a | 11282 : 11296 | 1/16863 | 72 | N | 28304 : 28309 | 5/23176 |
| 33 | ORF1a | 12620 : 12625 | 2/16863 | 73 | N | 28880 : 28891 | 1/23176 |
| 34 | ORF1b | 19516 : 19539 | 1/14252 | 74 | N | 28886 : 28903 | 1/23176 |
| 35 | ORF1b | 20410 : 20424 | 1/14252 | 75 | N | 28898 : 28903 | 2/23176 |
| 36 | S | 21737 : 21766 | 2/16851 | 76 | N | 28898 : 28909 | 2/23176 |
| 37 | S | 21929 : 21937 | 1/16851 | 77 | N | 28988 : 28993 | 1/23176 |
| 38 | S | 21953 : 21958 | 1/16851 | 78 | N | 29366 : 29386 | 1/23176 |
| 39 | S | 21953 : 21973 | 1/16851 | 79 | N | 29444 : 29452 | 1/23176 |
| 40 | S | 21959 : 21970 | 3/16851 |  |  |  |  |

# Supplementary Table 5. ORF region amino acid insert-mutation information list

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| No. | Gene | Location | Frequency | No. | Gene | Location | Frequency |
| 1 | ORF1a | 11083 : 11084 | 33/16863 | 3 | ORF1b | 14607 : 14608 | 1/14252 |
| 2 | ORF1a | 3946 : 3947 | 1/16863 | 4 | ORF1b | 21387 : 21388 | 1/14252 |

# Supplementary Table 6. Prototype sequence ID of haplotypes in Fig.4.

|  |  |
| --- | --- |
| Haplotype Label | Prototype ID |
| L\_1 | EPI\_ISL\_402123 |
| S\_1 | EPI\_ISL\_406801 |
| S\_2 | EPI\_ISL\_408484 |
| S\_3 | EPI\_ISL\_408480 |
| Other\_1 | EPI\_ISL\_408481 |
| S\_4 | EPI\_ISL\_404895 |
| Other\_2 | EPI\_ISL\_408482 |
| Other\_3 | EPI\_ISL\_406036 |
| L\_2 | EPI\_ISL\_406533 |
| L\_3 | EPI\_ISL\_406534 |
| G\_1 | EPI\_ISL\_422425 |
| V\_1 | EPI\_ISL\_415709 |
| L\_4 | EPI\_ISL\_410044 |
| G\_2 | EPI\_ISL\_406862 |
| L\_5 | EPI\_ISL\_421261 |
| Other\_4 | EPI\_ISL\_416331 |
| L\_6 | EPI\_ISL\_410486 |
| S\_5 | EPI\_ISL\_426182 |
| V\_2 | EPI\_ISL\_427810 |
| S\_6 | EPI\_ISL\_413456 |
| GH\_1 | EPI\_ISL\_418218 |
| G\_3 | EPI\_ISL\_420456 |
| S\_7 | EPI\_ISL\_419834 |
| GR\_1 | EPI\_ISL\_412912 |
| S\_8 | EPI\_ISL\_414623 |
| G\_4 | EPI\_ISL\_418251 |
| V\_3 | EPI\_ISL\_413019 |
| GR\_2 | EPI\_ISL\_413997 |
| Other\_5 | EPI\_ISL\_415741 |
| GH\_2 | EPI\_ISL\_418219 |
| V\_4 | EPI\_ISL\_427809 |
| G\_5 | EPI\_ISL\_414019 |
| L\_7 | EPI\_ISL\_414505 |
| GR\_3 | EPI\_ISL\_419559 |
| GH\_3 | EPI\_ISL\_414626 |
| GH\_4 | EPI\_ISL\_418345 |
| GH\_5 | EPI\_ISL\_420791 |
| G\_6 | EPI\_ISL\_413589 |
| GR\_4 | EPI\_ISL\_413647 |
| L\_8 | EPI\_ISL\_413573 |
| GR\_5 | EPI\_ISL\_415702 |
| GR\_6 | EPI\_ISL\_416140 |
| V\_5 | EPI\_ISL\_422865 |
| G\_7 | EPI\_ISL\_414629 |
| L\_9 | EPI\_ISL\_416740 |
| S\_9 | EPI\_ISL\_420786 |
| S\_10 | EPI\_ISL\_428683 |
| Other\_6 | EPI\_ISL\_416032 |
| GR\_7 | EPI\_ISL\_416034 |
| Other\_7 | EPI\_ISL\_417444 |
| Other\_8 | EPI\_ISL\_422407 |
| V\_6 | EPI\_ISL\_426027 |
| S\_11 | EPI\_ISL\_417126 |
| V\_7 | EPI\_ISL\_417268 |
| S\_12 | EPI\_ISL\_418330 |
| S\_13 | EPI\_ISL\_418848 |
| GH\_6 | EPI\_ISL\_420322 |
| Other\_9 | EPI\_ISL\_420339 |
| GR\_8 | EPI\_ISL\_420348 |
| GR\_9 | EPI\_ISL\_420354 |
| G\_8 | EPI\_ISL\_426420 |
| G\_9 | EPI\_ISL\_420321 |
| G\_10 | EPI\_ISL\_415708 |
| GR\_10 | EPI\_ISL\_417992 |
| V\_8 | EPI\_ISL\_415478 |
| G\_11 | EPI\_ISL\_422864 |
| Other\_10 | EPI\_ISL\_436061 |
| G\_12 | EPI\_ISL\_415460 |
| G\_13 | EPI\_ISL\_417969 |
| GR\_11 | EPI\_ISL\_424054 |
| GH\_7 | EPI\_ISL\_424868 |
| Other\_11 | EPI\_ISL\_425845 |
| S\_14 | EPI\_ISL\_428699 |
| GH\_8 | EPI\_ISL\_434455 |
| Other\_12 | EPI\_ISL\_436060 |
| Other\_13 | EPI\_ISL\_436063 |
| GH\_9 | EPI\_ISL\_416521 |
| GH\_10 | EPI\_ISL\_426293 |
| GH\_11 | EPI\_ISL\_430136 |
| G\_14 | EPI\_ISL\_418965 |
| Other\_14 | EPI\_ISL\_430848 |
| L\_10 | EPI\_ISL\_415920 |
| G\_15 | EPI\_ISL\_417727 |
| G\_16 | EPI\_ISL\_417786 |
| G\_17 | EPI\_ISL\_417788 |
| GH\_12 | EPI\_ISL\_421502 |
| S\_15 | EPI\_ISL\_424673 |
| GH\_13 | EPI\_ISL\_427530 |
| GH\_14 | EPI\_ISL\_429161 |
| S\_16 | EPI\_ISL\_436211 |
| S\_17 | EPI\_ISL\_417353 |
| Other\_15 | EPI\_ISL\_419771 |
| GR\_12 | EPI\_ISL\_417509 |
| GR\_13 | EPI\_ISL\_418373 |
| V\_9 | EPI\_ISL\_425648 |
| L\_11 | EPI\_ISL\_425816 |
| V\_10 | EPI\_ISL\_420177 |
| S\_18 | EPI\_ISL\_444532 |
| L\_12 | EPI\_ISL\_418159 |
| S\_19 | EPI\_ISL\_418897 |
| GH\_15 | EPI\_ISL\_419811 |
| G\_18 | EPI\_ISL\_422847 |
| Other\_16 | EPI\_ISL\_422850 |
| GH\_16 | EPI\_ISL\_427603 |
| GR\_14 | EPI\_ISL\_428881 |
| GR\_15 | EPI\_ISL\_417538 |
| G\_19 | EPI\_ISL\_420361 |
| GH\_17 | EPI\_ISL\_421349 |
| GH\_18 | EPI\_ISL\_429869 |
| GH\_19 | EPI\_ISL\_444788 |
| G\_20 | EPI\_ISL\_417534 |
| GH\_20 | EPI\_ISL\_421420 |
| GR\_16 | EPI\_ISL\_421483 |
| V\_11 | EPI\_ISL\_421301 |
| GH\_21 | EPI\_ISL\_426315 |
| S\_20 | EPI\_ISL\_419728 |
| S\_21 | EPI\_ISL\_424199 |
| S\_22 | EPI\_ISL\_426453 |
| GH\_22 | EPI\_ISL\_430229 |
| GH\_23 | EPI\_ISL\_434824 |
| S\_23 | EPI\_ISL\_434827 |
| V\_12 | EPI\_ISL\_419928 |
| Other\_17 | EPI\_ISL\_419965 |
| V\_13 | EPI\_ISL\_425892 |
| G\_21 | EPI\_ISL\_430856 |
| GH\_24 | EPI\_ISL\_429016 |
| GH\_25 | EPI\_ISL\_434871 |
| GR\_17 | EPI\_ISL\_420393 |
| S\_24 | EPI\_ISL\_426942 |
| Other\_18 | EPI\_ISL\_437197 |
| Other\_19 | EPI\_ISL\_420422 |
| GR\_18 | EPI\_ISL\_433350 |
| GH\_26 | EPI\_ISL\_427194 |
| GH\_27 | EPI\_ISL\_434928 |
| GH\_28 | EPI\_ISL\_435450 |
| GH\_29 | EPI\_ISL\_427264 |
| S\_25 | EPI\_ISL\_437495 |
| G\_22 | EPI\_ISL\_425976 |
| GH\_30 | EPI\_ISL\_444683 |
| G\_23 | EPI\_ISL\_422599 |
| Other\_20 | EPI\_ISL\_437199 |
| GH\_31 | EPI\_ISL\_430970 |
| GH\_32 | EPI\_ISL\_443258 |
| GH\_33 | EPI\_ISL\_430974 |
| GR\_19 | EPI\_ISL\_432237 |
| GH\_34 | EPI\_ISL\_435461 |
| GH\_35 | EPI\_ISL\_427451 |
| G\_24 | EPI\_ISL\_433786 |
| GR\_20 | EPI\_ISL\_433844 |
| V\_14 | EPI\_ISL\_437367 |
| GH\_36 | EPI\_ISL\_433448 |
| GR\_21 | EPI\_ISL\_433141 |
| G\_25 | EPI\_ISL\_437746 |