**Appendix A. Supplementary material: Accession numbers on NCBI**

**A.1 Information from homo sapiens cytochrome oxidase subunit I (COI) gene.**

>EU834863: Homo sapiens cytochrome oxidase subunit I (COI) gene, partial cds; mitochondrial

TAGCCTCCTTATTCGAGCCGAGCTGGGCCAGCCAGGCAACCTTCTAGGTAACGACCACATCTACAACGTTATCGTCACAGCCCATGCATTTGTAATAATCTTCTTCATAGTAATACCCATCATAATCGGAGGCTTTGGCAACTGACTAGTTCCCCTAATAATCGGTGCCCCCGATATGGCGTTTCCCCGCATAAACAACATAAGCTTCTGACTCTTACCTCCCTCTCTCCTACTCCTGCTCGCATCTGCTATAGTGGAGGCCGGAGCAGGAACAGGTTGAACAGTCTACCCTCCCTTAGCAGGGAACTACTCCCACCCTGGAGCCTCCGTAGACCTAACCATCTTCTCCTTACACCTAGCAGGTGTCTCCTCTATCTTAGGGGCCATCAATTTCATCACAACAATTATCAATATAAAACCCCCTGCCATAACCCAATACCAAACGCCCCTCTTCGTCTGATCCGTCCTAATCACAGCAGTCCTACTTCTCCTATCTCTCCCAGTCCTAGCTGCTGGCATCACTATACTACTAACAGACCGCAACCTCAACACCACCTTCTTCGACCCCGCCGGAGGAGGAGACCCCATTCTATACCAACACCTATTCTTGATTCTTA

**A.2 Information from GenBank of the 38 Influenza A viruses**

|  |  |  |
| --- | --- | --- |
| Accession  Number | Length  (nt) | Description |
| HM370969 | 1419 | A/turkey/Ontario/FAV110-4/2009(H1N1) |
| CY138562 | 1422 | A/mallard/Nova Scotia/00088/2010(H1N1) |
| CY149630 | 1433 | A/thick-billed murre/Canada/1871/2011(H1N1) |
| KC608160 | 1398 | A/duck/Guangxi/030D/2009(H1N1) |
| AM157358 | 1413 | A/mallard/France/691/2002(H1N1) |
| AB470663 | 1422 | A/duck/Hokkaido/w73/2007(H1N1) |
| AB546159 | 1410 | A/pintail/Miyagi/1472/2008(H1N1) |
| HQ897966 | 1410 | A/mallard/Korea/KNU YP09/2009(H1N1) |
| EU026046 | 1433 | A/mallard/Maryland/352/2002(H1N1) |
| FJ357114 | 1433 | A/mallard/Maryland/26/2003(H1N1) |
| GQ411894 | 1413 | A/dunlin/Alaska/44421-660/2008(H1N1) |
| CY140047 | 1433 | A/mallard/Minnesota/Sg-00620/2008(H1N1) |
| KM244078 | 1410 | A/turkey/Virginia/4135/2014(H1N1) |
| HQ185381 | 1350 | A/chicken/Eastern China/XH222/2008(H5N1) |
| HQ185383 | 1350 | A/duck/Eastern China/JS017/2009(H5N1) |
| EU635875 | 1350 | A/chicken/Yunnan/chuxiong01/2005(H5N1) |
| FM177121 | 1370 | A/chicken/Germany/R3234/2007(H5N1) |
| AM914017 | 1350 | A/domestic duck/Germany/R1772/2007(H5N1) |
| KF572435 | 1350 | A/wild bird/Hong Kong/07035-1/2011(H5N1) |
| AF509102 | 1366 | A/Chicken/Hong Kong/822.1/01 (H5N1) |
| AB684161 | 1350 | A/chicken/Miyazaki/10/2011(H5N1) |
| EF541464 | 1350 | A/chicken/Korea/es/2003(H5N1) |
| JF699677 | 1350 | A/mandarin duck/Korea/K10-483/2010(H5N1) |
| GU186511 | 1370 | A/turkey/VA/505477-18/2007(H5N1) |
| EU500854 | 1453 | A/American black duck/NB/2538/2007(H7N3) |
| CY129336 | 1428 | A/American black duck/New Brunswick/02490/2007(H7N3) |
| CY076231 | 1420 | A/American green-winged teal/California/44242-906/2007(H7N3) |
| CY039321 | 1434 | A/avian/Delaware Bay/226/2006(H7N3) |
| AY646080 | 1453 | A/chicken/British Columbia/GSC\_human\_B/04(H7N3) |
| KF259734 | 1398 | A/chicken/Rizhao/713/2013(H7N9) |
| KF938945 | 1404 | A/chicken/Jiangsu/1021/2013(H7N9) |
| KF259688 | 1413 | A/duck/Jiangxi/3096/2009(H7N9) |
| KC609801 | 1426 | A/wild duck/Korea/SH19-47/2010(H7N9) |
| CY014788 | 1460 | A/turkey/Minnesota/1/1988(H7N9) |
| CY186004 | 1422 | A/mallard/Minnesota/AI09-3770/2009(H7N9) |
| DQ017487 | 1467 | A/mallard/Postdam/178-4/1983(H2N2) |
| [CY005540](http://www.ncbi.nlm.nih.gov/entrez/viewer.fcgi?val=CY005540) | 1467 | A/duck/Hong Kong/319/1978(H2N2) |
| [JX081142](http://www.ncbi.nlm.nih.gov/entrez/viewer.fcgi?val=JX081142) | 1457 | A/emperor goose/Alaska/44297-260/2007(H2N2) |

**A.3 Information from GenBank of the 12 primates**

|  |  |  |
| --- | --- | --- |
| Accession  Number | Length  (nt) | Description |
| M22653 | 896 | MacacaA fascicular |
| M22651 | 896 | MacacaB fuscata |
| M22650 | 896 | MacacaC mulatta |
| M22655 | 893 | Saimir sciureus |
| M22654 | 896 | Macaca sylvanus |
| V00672 | 896 | Chimpanzee |
| M22657 | 895 | Lemur catta |
| V00658 | 896 | Gorilla |
| V00659 | 896 | Hylobates |
| V00675 | 895 | Orangutan |
| M22656 | 895 | Tarsisus syrichta |
| L00016 | 896 | Human |

**A.4 Information from GenBank of the 113 HRV and 3 HEV**

|  |  |  |  |
| --- | --- | --- | --- |
| Genome names on tree | Accession Number | Class | Length |
| cva-13 | AF499637 | HEV-C | 7458 |
| cva-21 | AF546702 | HEV-C | 7406 |
| pv-1m | V01149 | HEV-C | 7440 |
| hrv-03 | DQ473485 | HRV-B | 7208 |
| hrv-04 | DQ473490 | HRV-B | 7212 |
| hrv-05 | FJ445112 | HRV-B | 7212 |
| hrv-06 | DQ473486 | HRV-B | 7216 |
| hrv-14 | L05355 | HRV-B | 7212 |
| hrv-17 | EF173420 | HRV-B | 7219 |
| hrv-26 | FJ445124 | HRV-B | 7211 |
| hrv-27 | FJ445186 | HRV-B | 7217 |
| hrv-35 | FJ445187 | HRV-B | 7224 |
| hrv-37 | EF173423 | HRV-B | 7216 |
| hrv-42 | FJ445130 | HRV-B | 7223 |
| hrv-48 | DQ473488 | HRV-B | 7214 |
| hrv-52 | FJ445188 | HRV-B | 7216 |
| hrv-69 | FJ445151 | HRV-B | 7211 |
| hrv-70 | DQ473489 | HRV-B | 7223 |
| hrv-72 | FJ445153 | HRV-B | 7216 |
| hrv-79 | FJ445155 | HRV-B | 7224 |
| hrv-83 | FJ445161 | HRV-B | 7230 |
| hrv-84 | FJ445162 | HRV-B | 7201 |
| hrv-86 | FJ445164 | HRV-B | 7213 |
| hrv-91 | FJ445168 | HRV-B | 7221 |
| hrv-92 | FJ445169 | HRV-B | 7233 |
| hrv-93 | EF173425 | HRV-B | 7215 |
| hrv-97 | FJ445172 | HRV-B | 7207 |
| hrv-99 | FJ445174 | HRV-B | 7208 |
| hrv-52-f10 | FJ445137.1 | HRV-B | 7216 |
| hrv-01 | FJ445111 | HRV-A | 7137 |
| hrv-02 | X02316 | HRV-A | 7102 |
| hrv-07 | FJ445176 | HRV-A | 7146 |
| hrv-08 | FJ445113 | HRV-A | 7108 |
| hrv-09 | FJ445177 | HRV-A | 7132 |
| hrv-09-f01 | FJ445114.1 | HRV-A | 7134 |
| hrv-09-f02 | FJ445115.1 | HRV-A | 7133 |
| hrv-13-f03 | FJ445117.1 | HRV-A | 7143 |
| hrv-49-f04 | FJ445134.1 | HRV-A | 7109 |
| hrv-54-f05 | FJ445139.1 | HRV-A | 7133 |
| hrv-10 | FJ445178 | HRV-A | 7137 |
| hrv-11 | EF173414 | HRV-A | 7125 |
| hrv-12 | EF173415 | HRV-A | 7124 |
| hrv-13 | FJ445116 | HRV-A | 7140 |
| hrv-15 | DQ473493 | HRV-A | 7134 |
| hrv-16 | L24917 | HRV-A | 7124 |
| hrv-18 | FJ445118 | HRV-A | 7119 |
| hrv-19 | FJ445119 | HRV-A | 7135 |
| hrv-21 | FJ445121 | HRV-A | 7134 |
| hrv-22 | FJ445122 | HRV-A | 7129 |
| hrv-23 | DQ473497 | HRV-A | 7025 |
| hrv-24 | FJ445190 | HRV-A | 7132 |
| hrv-25 | FJ445123 | HRV-A | 7126 |
| hrv-28 | DQ473508 | HRV-A | 7148 |
| hrv-29 | FJ445125 | HRV-A | 7123 |
| hrv-30 | FJ445179 | HRV-A | 7099 |
| hrv-31 | FJ445126 | HRV-A | 7131 |
| hrv-32 | FJ445127 | HRV-A | 7133 |
| hrv-33 | FJ445128 | HRV-A | 7133 |
| hrv-34 | FJ445189 | HRV-A | 7119 |
| hrv-36 | DQ473505 | HRV-A | 7141 |
| hrv-38 | FJ445180 | HRV-A | 7136 |
| hrv-39 | AY751783 | HRV-A | 7136 |
| hrv-40 | FJ445129 | HRV-A | 7138 |
| hrv-41 | DQ473491 | HRV-A | 7145 |
| hrv-43 | FJ445131 | HRV-A | 7129 |
| hrv-44 | DQ473499 | HRV-A | 7123 |
| hrv-45 | FJ445132 | HRV-A | 7114 |
| hrv-46 | DQ473506 | HRV-A | 7149 |
| hrv-47 | FJ445133 | HRV-A | 7132 |
| hrv-49 | DQ473496 | HRV-A | 7109 |
| hrv-50 | FJ445135 | HRV-A | 7118 |
| hrv-51 | FJ445136 | HRV-A | 7152 |
| hrv-53 | DQ473507 | HRV-A | 7143 |
| hrv-54 | FJ445138 | HRV-A | 7134 |
| hrv-55 | DQ473511 | HRV-A | 7036 |
| hrv-56 | FJ445140 | HRV-A | 7136 |
| hrv-57 | FJ445141 | HRV-A | 7134 |
| hrv-58 | FJ445142 | HRV-A | 7140 |
| hrv-59 | DQ473500 | HRV-A | 7135 |
| hrv-60 | FJ445143 | HRV-A | 7139 |
| hrv-61 | FJ445144 | HRV-A | 7139 |
| hrv-62 | FJ445145 | HRV-A | 7131 |
| hrv-63 | FJ445146 | HRV-A | 7141 |
| hrv-64 | FJ445181 | HRV-A | 7129 |
| hrv-65 | FJ445147 | HRV-A | 7162 |
| hrv-66 | FJ445148 | HRV-A | 7139 |
| hrv-67 | FJ445149 | HRV-A | 7135 |
| hrv-71 | FJ445152 | HRV-A | 7161 |
| hrv-73 | DQ473492 | HRV-A | 7140 |
| hrv-74 | DQ473494 | HRV-A | 7120 |
| hrv-75 | DQ473510 | HRV-A | 7137 |
| hrv-76 | FJ445182 | HRV-A | 7128 |
| hrv-77 | FJ445154 | HRV-A | 7136 |
| hrv-78 | FJ445183 | HRV-A | 7145 |
| hrv-80 | FJ445156 | HRV-A | 7138 |
| hrv-81 | FJ445157 | HRV-A | 7116 |
| HRV-81-f06 | FJ445158.1 | HRV-A | 7116 |
| HRV-81-f07 | FJ445159.1 | HRV-A | 7116 |
| hrv-82 | FJ445160 | HRV-A | 7123 |
| hrv-85 | FJ445163 | HRV-A | 7140 |
| hrv-88 | DQ473504 | HRV-A | 7143 |
| hrv-89 | FJ445184 | HRV-A | 7152 |
| hrv-89-f08 | FJ445166.1 | HRV-A | 7150 |
| hrv-89-f09 | FJ445165.1 | HRV-A | 7152 |
| hrv-90 | FJ445167 | HRV-A | 7124 |
| hrv-94 | FJ445185 | HRV-A | 7132 |
| hrv-95 | FJ445170 | HRV-A | 7110 |
| hrv-96 | FJ445171 | HRV-A | 7134 |
| hrv-98 | FJ445173 | HRV-A | 7133 |
| hrv-100 | FJ445175 | HRV-A | 7140 |
| qpm | EF186077 | HRV-C | 6917 |
| nat001 | EF077279 | HRV-C | 7079 |
| c024 | EF582385 | HRV-C | 7099 |
| nat045 | EF077280 | HRV-C | 7015 |
| c026 | EF582387 | HRV-C | 7086 |
| c025 | EF582386 | HRV-C | 7114 |

**A.5 Sequences of VIPR1-AS1 and artificial mutations**

* Original VIPR1-AS1 gene sequence:

>NC\_000003.12:c42532606-42530896 Homo sapiens chromosome 3, GRCh38.p12 Primary Assembly

CTCCCTGGCTTGGCAGCAGATGCATACCTGGGAAGGATGCTAGGTGAGTGTGGGCAGGAGAAGCATGCAGGGCTCTGAGTGCAGCCTGGTGAGGGTGGGGCTGGAGCAGGGGATGGTGGTGGGCTGAGCCAGGCCATGGTGGAGGTGGGAAAGAACAATGTGGCTCTTTGGTGACTCTGGATGTTTGGGGTGGGAGGACTTCAAGGAGATGTGGGATGATTTGAGGACTGGGGATGGAGGTACTGGGGGCTGAGGCACTAGGCCCACACTCACGAGTATGGACTGCTGTCACTCTTCCTGATATCTGGGGGCCGCAGTTTCTGAAGCAGGATTCGGATGATGCAAATAAACAGGATGAAGTTTACCTAGTGGGTGGGGACCCGAGTTCGGGCAGTCAGAGCGGGAAGGCTGAGGTGTTCAGGCCCCTTGACTGCTGGCCTGTCTTCTTTCCCAGGGTCCTGCTGCCCCTCTCTCTATCTTACCTCTCCTCTGGCATTTCCCCTTTGGGCAGGTCATCCGGGAACTCTACCTCCTTCAAATCCCTAAGGACTGTGCTCCCAATCCGCTTACGCTCAAGGAAGAACTGGTAGGACAGGGGTGGGGATGATCCTGCATTGGGCATTAGGAAGCTACGTTTCAGTTCTGACCTAGATACTAATTTCCCATGTGACCTTGGGCTAAGTTGCCTGCCCTTTGGGCCTGTTTCCCCATCTCTAGGTGGTGGGAGGGTATCTTACCAAGATGGAGGTGAGGATGGGGCCCTTTATGATCCACCACAGTGAGGAGTTGATGGTGTCCCAGCACCTGAGCAGACCGTGGGGAGGAATGAGAGGGATTGTCCTCAGCCAGAGAGAGACTCAGCAGCACCTCCCCCAGTTGTCCCCAGCTCTGCTCCTGAGCACTTTAGCAACCCCGGGCCCAGAGTCTGTTGCTCCCCAGGTCCTCCTCCAGCCTCCCCTCTGGCCCGAGAGCTGTGGTTTTTGTCCACTCACCAAGGCCAGATGGCATTATCATCCCACCCAGGGGGCCTGCCCAAGTGATGGCGGCCGGGGGAGTGTGTGGGGCAGCAGCTCACCCATAATCCTCAAAATGGATCCTGGCGATGGTCCACACCATGGTGAATGTGCTGGGTACCCCTGTCAGGCCCAGGGAGAGTGAAAGAGCAGAGAGGGCACAGGAAGCAGGGGTAGAGGGCATGAGGGAGAGATTTTGGAGAAAAGCAGGGAGAGGGAGGGAGAGAGAAAAGGGTGGGTTGTCAGTCTGCTGTCTTTGGTTGCATAGGTTGTTCACCACGGAGGGATGCTCCACTGAGGGGGTGAAGCTGTATGCCTGAAGGGCTGTGTCTACCTAGACGGACATTCTCTTTCTAATTGTGACAGAGGCCCTTTATAGATTAGCAGTGGCCCTGTGTATTTCGGGAACTAAAGGGAAATGGAAAGATGTTCACAAAATCTGTCCCACAGGTCAGCCCTAGGTGCAGCTGCAACCTGAGGGACTTGTCCTGGGATCAGACATTTTGAGGACTTTCTTGACCCTTGGCTGATATCCTTGCAGGCAGGACCTGCAGCTAAGCAAGACGTAGGACTGCAAGCTGGGTTGGCACCCTCCCCCTAGGGAGTTCTCCAGGCCTTGCCCCCTCTGTCCCCAGCCTGGAAGCCCTCCCTGGTACCATACCCCAGCCGATGAGTATGTACCCCCAGAAGTACTTCCG

* Mutation-1 sequence:

CTCCAAAAACCCCCGGGGGTTTTTCTGGCTTGGCAGCAGATGCATACCTGGGAAGGATGCTAGGTGAGTGTGGGCAGGAGAAGCATGCAGGGCTCTGAGTGCAGCCTGGTGAGGGTGGGGCTGGAGCAGGGGATGGTGGTGGGCTGAGCCAGGCCATGGTGGAGGTGGGAAAGAACAATGTGGCTCTTTGGTGACTCTGGATGTTTGGGGTGGGAGGACTTCAAGGAGATGTGGGATGATTTGAGGACTGGGGATGGAGGTACTGGGGGCTGAGGCACTAGGCCCACACTCACGAGTATGGACTGCTGTCACTCTTCCTGATATCTGGGGGCCGCAGTTTCTGAAGCAGGATTCGGATGATGCAAATAAACAGGATGAAGTTTACCTAGTGGGTGGGGACCCGAGTTCGGGCAGTCAGAGCGGGAAGGCTGAGGTGTTCAGGCCCCTTGACTGCTGGCCTGTCTTCTTTCCCAGGGTCCTGCTGCCCCTCTCTCTATCTTACCTCTCCTCTGGCATTTCCCCTTTGGGCAGGTCATCCGGGAACTCTACCTCCTTCAAATCCCTAAGGACTGTGCTCCCAATCCGCTTACGCTCAAGGAAGAACTGGTAGGACAGGGGTGGGGATGATCCTGCATTGGGCATTAGGAAGCTACGTTTCAGTTCTGACCTAGATACTAATTTCCCATGTGACCTTGGGCTAAGTTGCCTGCCCTTTGGGCCTGTTTCCCCATCTCTAGGTGGTGGGAGGGTATCTTACCAAGATGGAGGTGAGGATGGGGCCCTTTATGATCCACCACAGTGAGGAGTTGATGGTGTCCCAGCACCTGAGCAGACCGTGGGGAGGAATGAGAGGGATTGTCCTCAGCCAGAGAGAGACTCAGCAGCACCTCCCCCAGTTGTCCCCAGCTCTGCTCCTGAGCACTTTAGCAACCCCGGGCCCAGAGTCTGTTGCTCCCCAGGTCCTCCTCCAGCCTCCCCTCTGGCCCGAGAGCTGTGGTTTTTGTCCACTCACCAAGGCCAGATGGCATTATCATCCCACCCAGGGGGCCTGCCCAAGTGATGGCGGCCGGGGGAGTGTGTGGGGCAGCAGCTCACCCATAATCCTCAAAATGGATCCTGGCGATGGTCCACACCATGGTGAATGTGCTGGGTACCCCTGTCAGGCCCAGGGAGAGTGAAAGAGCAGAGAGGGCACAGGAAGCAGGGGTAGAGGGCATGAGGGAGAGATTTTGGAGAAAAGCAGGGAGAGGGAGGGAGAGAGAAAAGGGTGGGTTGTCAGTCTGCTGTCTTTGGTTGCATAGGTTGTTCACCACGGAGGGATGCTCCACTGAGGGGGTGAAGCTGTATGCCTGAAGGGCTGTGTCTACCTAGACGGACATTCTCTTTCTAATTGTGACAGAGGCCCTTTATAGATTAGCAGTGGCCCTGTGTATTTCGGGAACTAAAGGGAAATGGAAAGATGTTCACAAAATCTGTCCCACAGGTCAGCCCTAGGTGCAGCTGCAACCTGAGGGACTTGTCCTGGGATCAGACATTTTGAGGACTTTCTTGACCCTTGGCTGATATCCTTGCAGGCAGGACCTGCAGCTAAGCAAGACGTAGGACTGCAAGCTGGGTTGGCACCCTCCCCCTAGGGAGTTCTCCAGGCCTTGCCCCCTCTGTCCCCAGCCTGGAAGCCCTCCCTGGTACCATACCCCAGCCGATGAGTATGTACCCCCAGAAGTACTTCCG

* Mutation-2 sequence:

CTCCCTGGCTTGGCAGCAGATGCATACCTGGGAAGGATGCTAGGTGAGTGTGGGCAGGAGAAGCATGCAGGGCTCTGAGTGCAGCCTGGTGAGGGTGGGGCTGGAGCAGGGGATGGTGGTGGGCTGAGCCAGGCCATGGTGGAGGTGGGAAAGAACAATGTGGCTCTTTGGTGACTCTGGATGTTTGGGGTGGGAGGACTTCAAGGAGATGTGGGATGATTTGAGGACTGGGGATGGAGGTACTGGGGGCTGAGGCACTAGGCCCACACTCACGAGTATGGACTGCTGTCACTCTTCCTGATATCTGGGGGCCGCAGTTTCTGAAGCAGGATTCGGATGATGCAAATAAACAGGATGAAGTTTACCTAGTGGGTGGGGACCCGAGTTCGGGCAGTCAGAGCGGGAAGGCTGAGGTGTTCAGGCCCCTTGACTGCTGGCCTGTCTTCTTTCCCAGGGTCCTGCTGCCCCTCTCTCTATCTTACCTCTCCTCTGGCATTTCCCCTTTGGGCAGGTCATCCGGGAACTCTACCTCCTTCAAATCCCTAAGGACTGTGCTCCCAATCCGCTTACGCTCAAGGAAGAACTGGTAGGACAGGGGTGGGGATGATCCTGCATTGGGCATTAGGAAGCTACGTTTCAGTTCTGACCTAGATACTAATTTCCCATGTGACCTTGGGCTAAGTTGCCTGCCCTTTGGGCCTGTTTCCCCATCTCTAGGTGGTGGGAGGGTATCTTACCAAGATGGAGGTGAGGATGGGGCCCTTTATGATCCACCACAGTGAGGAGTTGATGGTGTCCCAGCACCTGAGCAGACCGTGGGGAGGAATGAGAGGGATTGTCCTCAGCCAGAGAGAGACTCAGCAGCACCTCCCCCAGTTGTCCCCAGCTCTGCTCCTGAGCACTTTAGCAACCCCGGGCCCAGAGTCTGTTGCTCCCCAGGTCCTCCTCCAGCCTCCCCTCTGGCCCGAGAGCTGTGGTTTTTGTCCACTCACCAAGGCCAGATGGCATTATCATCCCACCCAGGGGGCCTGCCCAAGTGATGGCGGCCGGGGGAGTGTGTGGGGCAGCAGCTCACCCATAATCCTCAAAATGGATCCTGGCGATGGTCCACACCATGGTGAATGTGCTGGGTACCCCTGTCAGGCCCAGGGAGAGTGAAAGAGCAGAGAGGGCACAGGAAGCAGGGGTAGAGGGCATGAGGGAGAGATTTTGGAGAAAAGCAGGGAGAGGGAGGGAGAGAGAAAAGGGTGGGTTGTCAGTCTGCTGTCTTTGGTTGCATAGGTTGTTCACCACGGAGGGATGCTCCACTGAGGGGGTGAAGCTGTATGCCTGAAGGGCTGTGTCTACCTAGACGGACATTCTCTTTCTAATTGTGACAGAGGCCCTTTATAGATTAGCAGTGGCCCTGTGTATTTCGGGAACTAAAGGGAAATGGAAAGATGTTCACAAAATCTGTCCCACAGGTCAGCCCTAGGTGCAGCTGCAACCTGAGGGACTTGTCCTGGGATCAGACATTTTGAGGACTTTCTTGACCCTTGGCTGATATCCTTGCAGGCAGGACCTGCAGCTAAGCAAGACGTAGGACTGCAAGCTGGGTTGGCACCCTCCCCCTAGGGAGTTCTCCAGGCCTTGCCCCCTCTGTCCCCAGCCTGGAAGCCCTCCAAAAACCCCCGGGGGTTTTTCTGGTACCATACCCCAGCCGATGAGTATGTACCCCCAGAAGTACTTCCG

**Appendix B. Supplementary material: Theorem**

We now prove the theorem that the CPS method is better than PS because the moment vectors of CPS can recover power spectra directly as long as and are known, thus more information is kept. However, the traditional PS method cannot be recovered, which will be verified later in *Section B.2*.

***B.1 CPS can be recovered by moment vectors.***

First, we prove that CPS can be recovered given the first N-1 moment vectors. To do this, we only need to prove that the mapping between and is one-to-one. We have already shown that moment vectors can be decided given CPS; now we show that CPS can be decided by moment vectors.

We write

Consider the equation

Now we want to prove that, given , the equation above will have the roots , and those will be the only roots. Since is calculated by all the , the roots certainly include given . What we need to prove next is that those s are the only roots.

Consider the function

Using Newton's identities, each can be represented by , j=1,2, ...,N-1.

Since all the s are given, s are decided. And the Newton's identities can be stated as

Therefore, is determined and is decided.

Since CPS is increasing, we can put these in ascending order and we have

Then by subtraction between every two adjacent items and , we get the sequence of .

***B.2. PS cannot be recovered by the traditional power spectrum method***

Using the PS method, we cannot recover it from the moment vectors. We can decide , but since PS is neither increasing nor decreasing, we cannot put them in correct order; namely, we cannot match these to the .

***B.3. CPS can be recovered by central moment vectors***

For central moment vectors, the steps are almost the same. We can decide . Because is in the increasing order, it is obvious that the s are also increasing. Putting them in ascending order, we decide

We rewrite as , which is known, and as , which is unknown but a constant. So we have

By subtraction between every two adjacent items, constant is offset and using , we get the sequence of .

Although is unknown, the information is still much more than what is kept using the PS method.

***B.4. The choice of moment vectors and central moment vectors***

When we apply the moment vectors to genomes, we find that they become very small from the third moment vector, so we only use the first two moment vectors. For the central moment vectors, they also become very small from the third moment vectors. The moment vectors should converge to zero as N becomes large enough.