

Table S1. Samples selected by micro-PITA for metagenomic sequencing.

| Treatments | Sample | | | | | | | |
|------------------------------------|--------|------|------|------|------|------|------|------|
| Wild group (W group) | W36 | W42 | W10 | W40 | W15 | W41 | W34 | W38 |
| | W9 | W7 | W5 | W3 | W13 | W44 | W21 | |
| human disturbance group (HD group) | HD1 | HD4 | HD7 | HD31 | HD17 | HD50 | HD41 | HD34 |
| | HD16 | HD35 | HD33 | HD40 | HD44 | HD38 | HD47 | |

Table S2 Characteristics of high quality MAGs

| Bin Id | Contigs Num | N50 (contigs) (bp) | Mean contig length (bp) | Completeness (%) | Contamination (%) | Bins converag e | Cotigs contain (%) |
|-----------|-------------|--------------------|-------------------------|------------------|-------------------|-----------------|--------------------|
| bin570 | 502 | 2139537 | 23483 | 80.05 | 5.87 | 37 | 0.001944531 |
| bin580 | 405 | 3443 | 3256 | 57.82 | 2.78 | 95 | 0.001568795 |
| bin134 | 96 | 1524783 | 100348 | 62.05 | 5.8 | 147 | 0.000371862 |
| bin399 | 455 | 2823 | 2677 | 50.4 | 0.67 | 37 | 0.001762473 |
| bin379 | 19 | 83111 | 48057 | 50.83 | 0 | 171 | 7.35978E-05 |
| bin641 | 295 | 2429 | 2429 | 51.31 | 0.81 | 14 | 0.001142702 |
| bin360 | 363 | 2860 | 2794 | 51.37 | 0.67 | 27 | 0.001406105 |
| bin671 | 432 | 2363 | 2393 | 51.46 | 1.51 | 24 | 0.001673381 |
| bin388 | 390 | 3093 | 2852 | 53.03 | 3.52 | 72 | 0.001510691 |
| bin333 | 52 | 42622 | 24508 | 53.49 | 3.14 | 69 | 0.000201425 |
| bin248 | 272 | 2859 | 2701 | 54.23 | 3.37 | 28 | 0.00105361 |
| bin43 | 19 | 115017 | 65510 | 54.89 | 0.24 | 144 | 7.35978E-05 |
| bin400 | 351 | 3463 | 3147 | 54.96 | 0.45 | 37 | 0.001359622 |
| bin241 | 536 | 5103 | 4086 | 57.24 | 1.75 | 58 | 0.002076232 |
| bin239 | 341 | 3888 | 3472 | 57.76 | 0 | 27 | 0.001320886 |
| bin376 | 101 | 17424 | 13126 | 57.9 | 0.67 | 171 | 0.00039123 |
| bin27 | 195 | 10300 | 7684 | 67.01 | 0 | 455 | 0.000755346 |
| bin32 | 209 | 4059 | 3483 | 64.39 | 0 | 34 | 0.000809575 |
| bin410 | 23 | 66135 | 41129 | 61.6 | 0 | 189 | 8.9092E-05 |
| bin12 | 68 | 17962 | 11873 | 75.67 | 0.13 | 29 | 0.000263403 |
| bin34 | 48 | 22304 | 13578 | 61.94 | 0.16 | 69 | 0.000185931 |
| bin2 | 51 | 63217 | 41040 | 99.33 | 0.17 | 77 | 0.000197552 |
| bin36 | 339 | 5307 | 4464 | 74.34 | 0.17 | 16 | 0.001313139 |
| HD bin504 | 66 | 78904 | 36822 | 99.19 | 0.2 | 60 | 0.000255655 |
| bin291 | 52 | 48449 | 33590 | 69.62 | 0.27 | 93 | 0.000201425 |
| bin200 | 95 | 42686 | 18884 | 97.09 | 0.34 | 38 | 0.000367989 |

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|--------|-----|--------|-------|-------|------|-----|-------------|
| bin383 | 268 | 4338 | 3848 | 71.02 | 0.4 | 26 | 0.001038116 |
| bin431 | 223 | 12765 | 8605 | 95.3 | 0.45 | 58 | 0.000863805 |
| bin469 | 124 | 15063 | 10105 | 75.07 | 0.51 | 118 | 0.000480322 |
| bin438 | 308 | 8382 | 6003 | 94.3 | 0.56 | 38 | 0.001193059 |
| bin6 | 329 | 4759 | 4144 | 83.5 | 0.58 | 24 | 0.001274403 |
| bin638 | 292 | 13836 | 8393 | 95.86 | 0.62 | 19 | 0.001131081 |
| bin56 | 90 | 36174 | 22676 | 97.32 | 0.67 | 54 | 0.000348621 |
| bin394 | 95 | 27349 | 15780 | 76.44 | 0.67 | 70 | 0.000367989 |
| bin152 | 225 | 12626 | 9040 | 90.25 | 0.69 | 50 | 0.000871553 |
| bin600 | 25 | 108850 | 83463 | 91.61 | 0.72 | 390 | 9.68392E-05 |
| bin257 | 30 | 150574 | 67116 | 80.38 | 0.75 | 72 | 0.000116207 |
| bin5 | 338 | 9161 | 6310 | 95.97 | 0.81 | 43 | 0.001309266 |
| bin692 | 31 | 121699 | 56853 | 79.35 | 0.92 | 114 | 0.000120081 |
| bin711 | 312 | 6081 | 4838 | 84.33 | 0.94 | 44 | 0.001208553 |
| bin23 | 73 | 44694 | 24280 | 95.39 | 1.01 | 69 | 0.00028277 |
| bin660 | 142 | 21997 | 12675 | 89.26 | 1.01 | 55 | 0.000550046 |
| bin145 | 132 | 23791 | 13143 | 94.92 | 1.08 | 30 | 0.000511311 |
| bin472 | 209 | 16859 | 10971 | 72.09 | 1.08 | 97 | 0.000809575 |
| bin589 | 194 | 18139 | 11090 | 94.8 | 1.34 | 55 | 0.000751472 |
| bin273 | 54 | 45885 | 20729 | 80.85 | 1.4 | 46 | 0.000209173 |
| bin654 | 252 | 15850 | 10149 | 95.5 | 1.45 | 31 | 0.000976139 |
| bin30 | 374 | 3014 | 2877 | 60.28 | 1.46 | 20 | 0.001448714 |
| bin693 | 726 | 6985 | 5024 | 94.72 | 1.54 | 36 | 0.002812209 |
| bin474 | 129 | 33283 | 15394 | 95.57 | 1.58 | 45 | 0.00049969 |
| bin644 | 175 | 21731 | 12692 | 88.11 | 1.6 | 43 | 0.000677874 |
| bin497 | 355 | 5843 | 4709 | 90.88 | 1.61 | 31 | 0.001375116 |
| bin332 | 74 | 60012 | 27326 | 97.89 | 1.64 | 108 | 0.000286644 |
| bin446 | 116 | 36484 | 23295 | 96.98 | 1.67 | 27 | 0.000449334 |
| bin378 | 605 | 4309 | 3795 | 80.13 | 1.69 | 61 | 0.002343508 |
| bin52 | 261 | 22973 | 14965 | 98.58 | 1.77 | 46 | 0.001011001 |
| bin18 | 64 | 88264 | 33098 | 95.85 | 1.89 | 32 | 0.000247908 |
| bin515 | 422 | 3370 | 3113 | 67.79 | 1.89 | 45 | 0.001634645 |
| bin11 | 184 | 15064 | 10943 | 84.79 | 1.92 | 55 | 0.000712736 |
| bin310 | 171 | 8088 | 6415 | 64.24 | 1.95 | 263 | 0.00066238 |
| bin485 | 281 | 14925 | 9336 | 95.97 | 1.96 | 56 | 0.001088472 |
| bin361 | 87 | 81682 | 38466 | 98.66 | 2.01 | 96 | 0.000337 |
| bin734 | 282 | 8412 | 6411 | 92.37 | 2.01 | 24 | 0.001092346 |
| bin53 | 361 | 8648 | 6659 | 91.38 | 2.01 | 37 | 0.001398358 |
| bin284 | 431 | 4266 | 3512 | 61.13 | 2.05 | 31 | 0.001669507 |
| bin724 | 418 | 4719 | 4156 | 88.04 | 2.13 | 29 | 0.001619151 |
| bin553 | 102 | 22618 | 12642 | 70.74 | 2.13 | 276 | 0.000395104 |
| bin403 | 394 | 4421 | 3774 | 70.68 | 2.2 | 94 | 0.001526185 |
| bin162 | 58 | 128189 | 50018 | 98.31 | 2.22 | 265 | 0.000224667 |
| bin389 | 74 | 23454 | 14006 | 89.33 | 2.25 | 209 | 0.000286644 |

| | | | | | | | |
|--------|-----|--------|-------|-------|------|-----|-------------|
| bin46 | 217 | 8592 | 6176 | 85.86 | 2.25 | 56 | 0.000840564 |
| bin454 | 110 | 12322 | 8243 | 68.73 | 2.25 | 46 | 0.000426092 |
| bin717 | 80 | 103091 | 43318 | 99.26 | 2.31 | 29 | 0.000309885 |
| bin511 | 170 | 15155 | 8146 | 88.24 | 2.31 | 44 | 0.000658506 |
| bin313 | 147 | 18324 | 9418 | 73.25 | 2.32 | 62 | 0.000569414 |
| bin304 | 362 | 3958 | 3544 | 67.82 | 2.32 | 26 | 0.001402231 |
| bin395 | 142 | 30816 | 18014 | 96.06 | 2.35 | 37 | 0.000550046 |
| bin202 | 350 | 5173 | 4154 | 77.96 | 2.38 | 37 | 0.001355748 |
| bin85 | 406 | 6515 | 5018 | 91.37 | 2.48 | 43 | 0.001572668 |
| bin442 | 190 | 19663 | 10943 | 90.96 | 2.49 | 71 | 0.000735978 |
| bin533 | 155 | 39478 | 22114 | 96.04 | 2.68 | 61 | 0.000600403 |
| bin151 | 280 | 13131 | 8699 | 94.5 | 2.68 | 43 | 0.001084599 |
| bin28 | 258 | 4624 | 4054 | 73.65 | 2.69 | 15 | 0.00099938 |
| bin614 | 375 | 2631 | 2649 | 64.3 | 2.8 | 28 | 0.001452588 |
| bin211 | 372 | 4685 | 3990 | 81.68 | 2.84 | 81 | 0.001440967 |
| bin13 | 39 | 80971 | 56119 | 95.04 | 2.86 | 52 | 0.000151069 |
| bin168 | 549 | 8919 | 6158 | 94.65 | 2.97 | 32 | 0.002126588 |
| bin221 | 677 | 7862 | 5629 | 94.97 | 3.02 | 14 | 0.002622405 |
| bin131 | 96 | 45440 | 25025 | 96.67 | 3.15 | 96 | 0.000371862 |
| bin579 | 98 | 39077 | 19702 | 70.07 | 3.23 | 134 | 0.00037961 |
| bin144 | 507 | 5288 | 4272 | 84.89 | 3.25 | 25 | 0.001963898 |
| bin216 | 166 | 22264 | 13129 | 91.82 | 3.49 | 68 | 0.000643012 |
| bin490 | 427 | 4801 | 4089 | 84.01 | 3.52 | 45 | 0.001654013 |
| bin214 | 287 | 6681 | 5393 | 77.23 | 3.52 | 214 | 0.001111714 |
| bin73 | 504 | 10462 | 7038 | 90.72 | 3.54 | 24 | 0.001952278 |
| bin702 | 76 | 17417 | 12588 | 71.35 | 3.56 | 320 | 0.000294391 |
| bin491 | 222 | 20152 | 13237 | 93.06 | 3.58 | 88 | 0.000859932 |
| bin687 | 306 | 14569 | 9998 | 92.86 | 3.76 | 26 | 0.001185311 |
| bin205 | 461 | 4909 | 4206 | 86.76 | 3.79 | 17 | 0.001785714 |
| bin730 | 540 | 4234 | 3645 | 80.71 | 3.84 | 75 | 0.002091726 |
| bin645 | 295 | 12374 | 8123 | 95.72 | 3.9 | 97 | 0.001142702 |
| bin323 | 365 | 6044 | 4987 | 83.33 | 3.92 | 20 | 0.001413852 |
| bin358 | 150 | 13513 | 8223 | 92.7 | 3.93 | 92 | 0.000581035 |
| bin551 | 100 | 22466 | 12500 | 89.89 | 3.93 | 44 | 0.000387357 |
| bin188 | 258 | 6711 | 5005 | 86.6 | 3.93 | 56 | 0.00099938 |
| bin316 | 315 | 11330 | 7320 | 95.22 | 4.03 | 21 | 0.001220174 |
| bin300 | 403 | 6512 | 5175 | 89.75 | 4.26 | 24 | 0.001561047 |
| bin527 | 71 | 55445 | 22225 | 78.68 | 4.3 | 68 | 0.000275023 |
| bin147 | 223 | 12461 | 7855 | 93.86 | 4.31 | 40 | 0.000863805 |
| bin175 | 141 | 25115 | 14560 | 94.63 | 4.36 | 84 | 0.000546173 |
| bin568 | 166 | 11173 | 7611 | 76.63 | 4.38 | 99 | 0.000643012 |
| bin548 | 210 | 18372 | 12594 | 93.82 | 4.47 | 52 | 0.000813449 |
| bin7 | 268 | 13137 | 8303 | 97.93 | 4.63 | 39 | 0.001038116 |
| bin329 | 250 | 15837 | 9002 | 93.58 | 4.66 | 105 | 0.000968392 |

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|---|--------|-----|-------|-------|-------|------|-----|-------------|
| | bin566 | 311 | 3128 | 2883 | 61.1 | 4.73 | 111 | 0.001204679 |
| | bin623 | 449 | 4402 | 3842 | 77.98 | 4.81 | 25 | 0.001739231 |
| | bin220 | 313 | 8170 | 6564 | 92.35 | 4.98 | 41 | 0.001212426 |
| | bin126 | 317 | 2760 | 2657 | 50.85 | 2.07 | 24 | 0.00103002 |
| W | bin8 | 58 | 27680 | 17093 | 52.64 | 2.45 | 127 | 0.000188458 |
| | bin314 | 57 | 70651 | 16175 | 58.24 | 2.25 | 72 | 0.000185209 |
| | bin414 | 124 | 14466 | 8773 | 58.32 | 1.68 | 119 | 0.00040291 |
| | bin270 | 462 | 3593 | 3273 | 59.48 | 1.72 | 98 | 0.001501165 |
| | bin348 | 98 | 38187 | 22150 | 97.09 | 0 | 62 | 0.000318429 |
| | bin539 | 102 | 32505 | 19309 | 94.65 | 0 | 44 | 0.000331426 |
| | bin280 | 177 | 13058 | 8570 | 81.9 | 0 | 42 | 0.000575122 |
| | bin467 | 71 | 13341 | 10355 | 63.33 | 0 | 119 | 0.000230698 |
| | bin386 | 341 | 6521 | 5342 | 82.67 | 0.06 | 26 | 0.001108003 |
| | bin524 | 80 | 34088 | 22195 | 84.17 | 0.48 | 51 | 0.000259942 |
| | bin252 | 251 | 15769 | 8295 | 77.48 | 0.66 | 24 | 0.000815568 |
| | bin239 | 278 | 13664 | 8219 | 93.04 | 0.67 | 20 | 0.000903298 |
| | bin271 | 96 | 30273 | 17016 | 90.46 | 0.79 | 72 | 0.00031193 |
| | bin119 | 183 | 12913 | 8151 | 94.72 | 0.81 | 45 | 0.000594617 |
| | bin213 | 115 | 72691 | 24360 | 97.34 | 0.9 | 58 | 0.000373667 |
| | bin337 | 340 | 3437 | 3190 | 65.8 | 1.01 | 32 | 0.001104753 |
| | bin202 | 107 | 13088 | 9147 | 82.5 | 1.12 | 63 | 0.000347672 |
| | bin241 | 57 | 13035 | 9984 | 70.22 | 1.12 | 292 | 0.000185209 |
| | bin569 | 122 | 10198 | 7668 | 62.84 | 1.28 | 216 | 0.000396412 |
| | bin62 | 582 | 2758 | 2678 | 63.07 | 1.29 | 12 | 0.001891078 |
| | bin257 | 339 | 4323 | 3822 | 77.25 | 1.34 | 14 | 0.001101504 |
| | bin248 | 387 | 3666 | 3442 | 69.16 | 1.34 | 28 | 0.001257469 |
| | bin373 | 122 | 17863 | 11090 | 62.65 | 1.68 | 297 | 0.000396412 |
| | bin509 | 53 | 40878 | 22875 | 92.42 | 1.69 | 39 | 0.000172212 |
| | bin50 | 449 | 3228 | 2992 | 62.93 | 1.72 | 25 | 0.001458924 |
| | bin580 | 264 | 6646 | 4939 | 77.87 | 1.8 | 112 | 0.000857808 |
| | bin455 | 127 | 21860 | 10680 | 68.64 | 2.01 | 72 | 0.000412658 |
| | bin120 | 52 | 40550 | 23225 | 72.75 | 2.08 | 72 | 0.000168962 |
| | bin559 | 515 | 3564 | 3280 | 64.85 | 2.09 | 25 | 0.001673376 |
| | bin198 | 230 | 7595 | 5854 | 85.77 | 2.24 | 23 | 0.000747333 |
| | bin38 | 311 | 4656 | 4209 | 71.47 | 2.35 | 35 | 0.001010524 |
| | bin197 | 524 | 4385 | 3837 | 78.43 | 2.42 | 61 | 0.00170262 |
| | bin351 | 259 | 11797 | 8029 | 92.84 | 2.49 | 16 | 0.000841562 |
| | bin110 | 182 | 48727 | 26338 | 98.28 | 2.51 | 26 | 0.000591368 |
| | bin80 | 333 | 11850 | 7302 | 94.38 | 2.6 | 27 | 0.001082008 |
| | bin3 | 60 | 56929 | 29769 | 98.67 | 2.67 | 33 | 0.000194956 |
| | bin132 | 174 | 7190 | 5244 | 82.21 | 2.81 | 52 | 0.000565374 |
| | bin183 | 229 | 27826 | 12575 | 89.52 | 2.9 | 117 | 0.000744084 |
| | bin106 | 429 | 5674 | 4344 | 86.87 | 3.12 | 36 | 0.001393939 |
| | bin282 | 126 | 51091 | 18995 | 100 | 3.15 | 111 | 0.000409409 |

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|--------|-----|-------|-------|-------|------|-----|-------------|
| bin577 | 586 | 3786 | 3479 | 78.53 | 3.31 | 30 | 0.001904075 |
| bin44 | 459 | 4827 | 4146 | 79.42 | 3.35 | 33 | 0.001491417 |
| bin39 | 114 | 47404 | 18747 | 96.42 | 3.36 | 170 | 0.000370417 |
| bin141 | 246 | 10310 | 6865 | 93.79 | 3.38 | 46 | 0.000799322 |
| bin61 | 361 | 5583 | 4672 | 76.37 | 3.47 | 49 | 0.001172988 |
| bin533 | 139 | 14691 | 8550 | 68.89 | 3.58 | 98 | 0.000451649 |
| bin188 | 134 | 13857 | 8413 | 68.5 | 3.84 | 74 | 0.000435403 |
| bin193 | 153 | 12506 | 8003 | 80.9 | 3.93 | 58 | 0.000497139 |
| bin176 | 251 | 16865 | 8361 | 95.97 | 4.26 | 94 | 0.000815568 |
| bin553 | 519 | 5091 | 4289 | 88.55 | 4.47 | 31 | 0.001686374 |
| bin171 | 407 | 4120 | 3665 | 64.05 | 4.63 | 33 | 0.001322455 |
| bin143 | 467 | 3011 | 2845 | 72.86 | 4.64 | 32 | 0.001517411 |
| bin375 | 175 | 8262 | 6450 | 61.88 | 5 | 349 | 0.000568623 |

Table S3 Rotating component matrix in factor analysis (KMO and Bartlett tests, $P=0.000002$)

| | ARGs or VFs | F ₁ | F ₂ | F ₃ | F ₄ | F ₅ | F ₆ |
|------------------------------------|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Antibiotic resistance genes (ARGs) | Adherence | -0.138 | 0.052 | -0.171 | 0.065 | -0.854 | 0.086 |
| | Exoenzyme | -0.03 | -0.306 | -0.554 | 0.531 | 0.229 | 0.063 |
| | Immune modulation | 0.56 | -0.175 | -0.365 | 0.061 | -0.56 | 0.09 |
| | Nutritional/Metabolic factor | 0.957 | 0.017 | 0.128 | -0.102 | 0.074 | 0.057 |
| | Regulation | 0.90 | -0.046 | 0.216 | -0.214 | 0.148 | 0.071 |
| | Stress survival | 0.879 | 0.291 | -0.188 | -0.021 | -0.127 | -0.078 |
| | Biofilm | 0.231 | -0.178 | 0.651 | -0.178 | 0.447 | 0.252 |
| | Effector delivery system | 0.31 | 0.694 | 0.278 | 0.019 | 0.075 | 0.127 |
| | Exotoxin | 0.159 | 0.038 | 0.745 | 0.049 | 0.246 | -0.063 |
| | Motility | -0.226 | 0.691 | 0.056 | 0.085 | -0.217 | 0.086 |
| | Others | 0.805 | 0.088 | 0.355 | 0.128 | 0.162 | 0.078 |
| Virulence genes (VFs) | Multidrug | -0.194 | -0.511 | 0.02 | 0.74 | -0.041 | 0.064 |
| | Glycopeptide antibiotic | 0.263 | 0.761 | -0.412 | -0.191 | 0.18 | -0.025 |
| | Lincosamide antibiotic | -0.007 | -0.303 | 0.017 | -0.754 | 0.159 | 0.153 |
| | Aminoglycoside antibiotic | -0.072 | -0.124 | 0 | 0.063 | 0.086 | -0.942 |
| Variance Contributions (%) | | 25.457 | 14.4085 | 12.828 | 10.413 | 10.296 | 6.678 |

Note: The F₁, F₂, F₃, F₄, F₅ and F₆ are the factor loading of factor 1, factor 2, factor 3, factor 4, factor 5 and factor 6.
 $P=0.000002$ indicates that the factor analysis can be used to analyse the contribution of KEGG pathways in antimicrobial drug resistance and bacterial infectious disease to HR of golden snub-nosed monkeys.