**Supplemental materials**

|  |  |
| --- | --- |
| Gene name | Primer sequence（5'-3') |
| Sm16srDNA-F | AGCGTTGTCCGGATTTATTG |
| Sm16srDNA-R | CTACGCATTTCACCGCTACA |
| SMU\_651c-F | AACCTGCCCTAACTGATCGC |
| SMU\_651c-R | AGTCTGCTGCCGAGCTAAAA |
| SMU\_652c-F | AGCTGGTCTTGGTGTCATGG |
| SMU\_652c-R | AGAAGCAAGATGCAGGCTGA |
| SMU\_653c-F | ACCGTATTTAACGCCCAGCA |
| SMU\_653c-R | TTGCTCATGTTGCCCTTCCA |

*Supplemental Table1*. Quantitative reverse transcription polymerase chain reaction primers

|  |  |  |  |
| --- | --- | --- | --- |
|  | GO term | No. of up gene(*S.mutans-V.parvula* dual biofilmVS*S.mutans* mono biofilm) | No. of up gene(*S.mutans-V.parvula* dual biofilmVS*S.mutans mono* biofilm) |
| Biological process | biological regulation | 6 | 0 |
|  | cellular component organization or biogenesis | 8 | 0 |
|  | cellular process | 31 | 0 |
|  | establishment of localization | 4 | 0 |
|  | localization | 4 | 0 |
|  | metabolic process | 31 | 0 |
|  | regulation of biological process | 6 | 0 |
|  | response to stimulus | 3 | 0 |
|  | signaling | 1 | 0 |
| Cellular component | cell | 14 | 0 |
|  | cell part | 14 | 0 |
|  | extracellular region | 1 | 0 |
|  | macromolecular complex | 8 | 0 |
|  | membrane | 5 | 0 |
|  | membrane-enclosed lumen | 1 | 0 |
|  | membrane part | 4 | 0 |
|  | organelle | 8 | 0 |
|  | organelle part | 3 | 0 |
| Molecular function | binding | 23 | 0 |
|  | catalytic activity | 24 | 0 |
|  | molecular transducer activity | 1 | 0 |
|  | nucleic acid binding transcription factor activity | 1 | 0 |
|  | structural molecule activity | 5 | 0 |

*Supplemental Table2*. The gene expression difference of *S. mutans* and *S. mutans-V. parvula* dual biofilm

|  |  |  |  |
| --- | --- | --- | --- |
|  | GO term | No. of up gene(*sm-vp 250 vs sm-vp*) | No. of down gene(*sm-vp 250 vs sm-vp*) |
| Biological process | biological regulation | 14 | 4 |
|  | cellular component organization or biogenesis | 6 | 12 |
|  | cellular process | 41 | 50 |
|  | establishment of localization | 4 | 14 |
|  | localization | 4 | 14 |
|  | metabolic process | 50 | 55 |
|  | multi-organism process | 1 | 2 |
|  | regulation of biological process | 14 | 4 |
|  | response to stimulus | 3 | 5 |
|  | single-organism process | 28 | 40 |
|  | immune system process | 1 | 0 |
|  | signaling | 2 | 0 |
| Cellular component | cell | 23 | 32 |
|  | cell part | 23 | 32 |
|  | macromolecular complex | 7 | 17 |
|  | membrane | 4 | 17 |
|  | membrane-enclosed lumen | 1 | 1 |
|  | membrane part | 2 | 13 |
|  | organelle | 3 | 13 |
|  | organelle part | 1 | 5 |
| Molecular function | binding | 37 | 40 |
|  | catalytic activity | 34 | 43 |
|  | structural molecule activity | 1 | 9 |
|  | transporter activity | 1 | 11 |
|  | enzyme regulator activity | 1 | 0 |
|  | molecular transducer activity | 2 | 0 |
|  | nucleic acid binding transcription factor activity | 5 | 0 |
|  | protein binding transcription factor activity | 1 | 0 |

*Supplemental Table3*. The gene expression difference of *S. mutans-V. parvula* dual biofilm with and without 250μM copper ions

|  |  |  |  |
| --- | --- | --- | --- |
|  | GO term | No. of up gene(*sm-vp 500 vs sm-vp 250*) | No. of down gene(*sm-vp 500 vs sm-vp 250*) |
| Biological process | biological regulation | 14 | 4 |
|  | cellular component organization or biogenesis | 6 | 12 |
|  | cellular process | 41 | 50 |
|  | establishment of localization | 4 | 14 |
|  | localization | 4 | 14 |
|  | metabolic process | 50 | 55 |
|  | multi-organism process | 1 | 2 |
|  | regulation of biological process | 14 | 4 |
|  | response to stimulus | 3 | 5 |
|  | single-organism process | 28 | 40 |
|  | immune system process | 1 | 0 |
|  | signaling | 2 | 0 |
| Cellular component | cell | 23 | 32 |
|  | cell part | 23 | 32 |
|  | macromolecular complex | 7 | 17 |
|  | membrane | 4 | 17 |
|  | membrane-enclosed lumen | 1 | 1 |
|  | membrane part | 2 | 13 |
|  | organelle | 3 | 13 |
|  | organelle part | 1 | 5 |
| Molecular function | binding | 37 | 40 |
|  | catalytic activity | 34 | 43 |
|  | structural molecule activity | 1 | 9 |
|  | transporter activity | 1 | 11 |
|  | enzyme regulator activity | 1 | 0 |
|  | molecular transducer activity | 2 | 0 |
|  | nucleic acid binding transcription factor activity | 5 | 0 |
|  | protein binding transcription factor activity | 1 | 0 |

*Supplemental Table4.* The gene expression difference of *S. mutans-V. parvula* dual biofilm with 250μM copper ions and 500μM copper ions