**Table S1.** **Deletion mutations carried by *E. coli* K12 BZB1011 derivative strains**

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| --- | --- |
| **Mutant alleles** (a) | **Keio knockout strains**  **carrying the allele** |
| *ΔpinQ766::kan* | JW1538 (b) |
| *ΔpinR737::kan* | JW1368 (b) |
| *ΔybcK752::kan* | JW0532 (b) |
| *ΔpinQ766 ΔpinR737 ΔybcK752::kan* | JW1538, JW1368 and JW0532 |
| *Δpin-746::kan* | JW1144 (b) |
| *ΔintS756::kan* | JW2345 (b) |
| *ΔintB741::kan* | JW4227 (b) |
| *ΔintF725::kan* | JW0275 (b) |
| *ΔintA777::kan* | JW2602 (b) |
| *ΔintS756 ΔintB741 ΔintF725 ΔintA777::kan* | JW2345, JW4227, JW0275 and JW2602 |
| *ΔintD746::kan* | JW0525 (b) |
| *ΔintR772::kan* | JW1339 (b) |
| *ΔintD746 ΔintR772::kan* | JW0525 and JW1339 |
| *ΔintQ726::kan* | JW1571 (b) |
| *ΔintD746 ΔintQ726::kan* | JW0525 and JW1571 |
| *ΔintR772 ΔintQ726::kan* | JW1339 and JW1571 |
| *ΔintE729::kan* | JW1126 (b) |
| *ΔintD746 ΔintA777::kan* | JW0525 and JW2602 |
| *ΔintA777 ΔintQ726::kan* | JW2602 and JW1571 |
| *ΔintR772 ΔintA777::kan* | JW1339 and JW2602 |
| *ΔxerC757::kan* | JW3784 (b) |
| *ΔxerD745::kan* | JW2862 (b) |
| *ΔxerC757 ΔxerD745::kan* | JW3784 and JW2862 |
| *ΔfimB780::kan* | JW4275 (b) |
| *ΔfimE781::kan* | JW4276 (b) |
| *ΔfimB780 ΔfimE781::kan* | JW4275 and JW4276 |
| *ΔrecE787::kan* | JW1344 (b) |
| *ΔrecT786::kan* (d) | JW1343 (b) |
| *ΔrecA774::kan* (d) | JW2669 (c) |
| *ΔrecT786 ΔrecA774::kan* | JW1343 and JW2669 |
| *ΔtopB761::kan* | JW1752 (c) |
| *ΔrecB745::kan* | JW2788 (c) |
| *ΔrecC747::kan* | JW2790 (c) |
| *ΔrecD744::kan* | JW2787 (c) |
| *ΔrecF735::kan* | JW3677 (c) |
| *ΔrecR776::kan* | JW0461 (c) |
| *ΔrecO737::kan* | JW2549 (c) |
| *ΔrecJ743::kan* | JW2860 (c) |
| *ΔrecN772::kan* | JW5416 (c) |
| *ΔrecQ767::kan* | JW5855 (c) |
| *ΔrecG756::kan* | JW3627 (c) |
| *ΔsbcB780::kan* | JW1993 (c) |
| *ΔsbcC761::kan* | JW0387 (c) |
| *ΔsbcD762::kan* | JW0388 (c) |
| *ΔruvA786::kan* | JW1850 (c) |
| *ΔruvB785::kan* | JW1849 (c) |
| *ΔruvC789::kan* | JW1852 (c) |
| *ΔrecX773::kan* | JW2668 (c) |
| *ΔradA785::kan* | JW4352 (c) |
| *ΔexoX769::kan* | JW1833 (c) |
| *ΔrarA788::kan* | JW0875 (c) |
| *ΔseqA735::kan* | JW0674 (c) |
| *ΔhelD777::kan* | JW0945 (c) |
| *ΔuvrD769::kan* | JW3786 (c) |

(a)Allele numbers following the Coli Genetic Stock Center

(b) Provided by NBRP (NIG, Japan): E. coli

(c) Provided by the Coli Genetic Stock Center

(d) Deletion mutations confirmed by PCR using primers external to the genes