Two Lactococcus lactis thioredoxin paralogues play different roles in responses to arsenate and oxidative stress

Thioredoxin (Trx) maintains intracellular thiol groups in a reduced state and is involved in a wide range of cellular processes, including ribonucleotide reduction, sulphur assimilation, oxidative stress responses and arsenate detoxification. The industrially important lactic acid bacterium Lactococcus lactis contains two Trxs. TrxA is similar to the well-characterized Trx homologue from Escherichia coli and contains the common WCGPC active site motif, while TrxD is atypical and contains an aspartate residue in the active site (WCGDC). To elucidate the physiological roles of the two Trx paralogues, deletion mutants ΔtrxA, ΔtrxD and ΔtrxAΔtrxD were constructed. In general, the ΔtrxAΔtrxD strain was significantly more sensitive than either of the ΔtrxA and ΔtrxD mutants. Upon exposure to oxidative stress, growth of the ΔtrxA strain was diminished while that of the ΔtrxD mutant was similar to the wild-type. The lack of TrxA also appears to impair methionine sulfoxide reduction. Both ΔtrxA and ΔtrxD strains displayed growth inhibition after treatment with sodium arsenate and tellurite as compared with the wild-type, suggesting partially overlapping functions of TrxA and TrxD. Overall the phenotype of the ΔtrxA mutant matches established functions of WCGPC-type Trx while TrxD appears to play a more restricted role in stress resistance of Lac. lactis.