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Peroxiredoxin Tsa1 plays a role in growth, stress response and trehalose metabolism during wine yeast biomass propagation

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Wine industry is a key economic sector for the European economy. Nowadays, enological industry relies on the use of yeast starters for grape juice inoculation as Active Dry Yeast (ADY). During its industrial use in winemaking, yeasts, and particularly *Saccharomyces cerevisiae*, must withstand several stress conditions. Peroxiredoxins are a family of peroxide-degrading enzymes that challenge oxidative stress. They receive their reducing power from thioredoxins, and these from thioredoxin reductase. The main cytosolic peroxiredoxin Tsa1 acts as a redox switch controlling some metabolic enzymes like pyruvate kinase and the PKA pathway. Hence, Tsa1 is an ideal candidate for studying the control of metabolism by the redox status during yeast performance under industrial processes.

TSA1 deletion in L2056, a diploid industrial wine yeast strain, displays a growth defect during biomass production simulations on molasses, both in flask and bioreactor. Deletion of key player genes for Tsa1 functionality, such as sulfiredoxin SRX1 and one copy of cytosolic thioredoxin reductase TRR1, does not impact growth in molasses. This fact emphasizes that only Tsa1, and concretely its oxidized form, is required for cell proliferation under these conditions. tsa1Δ mutant reveals an alteration in its redox status, showing increased intracellular Reactive Oxygen Species (ROS) and changes in glutathione levels. Strikingly, it also presents a variety of metabolic changes that allow to confer new functions to Tsa1. During growth in molasses, Tsa1 impacts carbohydrate metabolism, repressing early accumulation of trehalose and glycogen, but being required for high trehalose levels during stationary phase. In flasks with sugar beet molasses, *tsa1*Δ mutant shows increased trehalase activities, both acid (Ath1/2) and neutral (Nth1), which do not correlate with trehalose levels. Additionally, TSA1 deletion diminishes yeast fermentative capacity in grape juice fermentation and alters acetic acid production, but the vinification profile does not significantly change.