Proteomics Analysis of Pollen Thermotolerance in Tomato Varieties with Contrasting Heat Tolerance Traits

Tomato *(Solanum lycopersicum)* is a model fruiting vegetable crop which requires optimal temperature (21°C-29°C; night/day) for pollination/fertilization and fruit set. Tomato production is threatened by the rising temperature (together with the drought) on global scale. This study aimed to identify proteins (genes) with critical roles in conferring heat tolerance for pollen production and germination. Two tomato varieties, the heat tolerant ‘Black Vernissage' and the heat sensitive 'Micro Tom', were grown under temperature regimes including the non-heat treated control (26±1°C), mild heat (32±1°C) and high heat (36± 1°C). The cell-type specific proteomes were identified for pollen cells at microsporogenesis, and germinating pollen grains (under in vitro conditions) using laser capture microdissection (LCM)-TMT mass spectrometry proteomics analysis. Functional enrichment analysis of the identified proteomes showed that the heat-induced significantly changed proteins affect meiosis and mitosis (identified in meiotic pollen mother cells), pollen exine formation (identified in microspores), programmed cell death (apoptosis and inhibitors), and stress responses including heat shock proteins, antioxidant enzymes and dehydration resistance/tolerance during the microsporogenesis. Proteins showing differential heat responses between the two tomato varieties are associated with the thermotolerance trait related to the decline in pollen production under heat stress. The heat-induced proteins in germinated pollen grains are identified from two sets of pollen grains: those developed at non-heat treated conditions but germinated at heat treated conditions, and those developed and germinated all at mild heat condition. Proteins identified in these samples are used to establish connection from pollen grain quality for pollen germination related to heat stress.