Making macho males by transgenic overexpression of a mitochondrial antioxidant enzyme

Many environmental stressors generate reactive oxygen species and a substantial body of work indicates that key life history traits from mating performance and sexual selection to longevity are mediated by oxidative stress. Here, we test the hypothesis that transgenic overexpression of a key antioxidant enzyme reduces oxidative damage and enhances mating performance in the context of oxidative stress. We have previously shown that females choose males with higher levels of antioxidant enzyme activity when exposed to oxidative stress prior to mating in the Caribbean fruit fly, Anastrepha suspensa, a species with a highly demanding lek mating system. Here we generated seven transgenic Caribbean fruit fly lines that overexpress mitochondrial superoxide dismutase (MnSOD), a key antioxidant enzyme that metabolizes damaging superoxide radicals. After exposure to severe oxidative stress, two of the lines with intermediate MnSOD overexpression showed enhanced mating performance relative to sterilized wild type males. In these two lines, improvements in mating performance and climbing corresponded with a reduction in oxidative damage to lipids, indicating that MnSOD overexpression protects flies from oxidative stress at the cellular level. Taken together, our results show a clear link between oxidative stress, antioxidant capacity and male performance, and our work shows promise for applications using transgenic approaches to enhance the efficiency of insects released as components of area-wide pest management strategies such as the sterile insect technique.