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Early life hormetic treatments decrease irradiation-induced oxidative damage, increase longevity, and enhance sexual performance during old age in the Caribbean fruit fly

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Abstract

Early life events can have dramatic consequences on performance later in life. Exposure to stressors at a young age affects development, the rate of aging, risk of disease, and overall lifespan. In spite of this, mild stress exposure early in life can have beneficial effects on performance later in life. These positive effects of mild stress are referred to as physiological conditioning hormesis. In our current study we used anoxia conditioning hormesis as a pretreatment to reduce oxidative stress and improve organismal performance, lifespan, and healthspan of Caribbean fruit flies. We used gamma irradiation to induce mild oxidative damage in a low-dose experiment, and massive oxidative damage in a separate high-dose experiment, in pharate adult fruit flies just prior to adult emergence. Irradiation-induced oxidative stress leads to reduced adult emergence, flight ability, mating performance, and lifespan. We used a hormetic approach, one hour of exposure to anoxia plus irradiation in anoxia, to lower post-irradiation oxidative damage. We have previously shown that this anoxic-conditioning treatment elevates total antioxidant capacity and lowers post-irradiation oxidative damage to lipids and proteins. In this study, conditioned flies had lower mortality rates and longer lifespan compared to those irradiated without hormetic conditioning. As a metric of healthspan, we tracked mating both at a young age (10 d) and old age (30 d). We found that anoxia-conditioned male flies were more competitive at young ages when compared to unconditioned irradiation stressed male flies, and that the positive effects of anoxic conditioning hormesis on mating success were even more pronounced in older males. Our data shows that physiological conditioning hormesis at a young age, not only improves immediate metrics of organismal performance (emergence, flight, mating), but the beneficial effects also carry into old age by reducing late life oxidative damage and improving lifespan and healthspan.

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Improving the sterile sperm identification method for its implementation in the area-wide sterile insect technique program against *Ceratitis capitata* (Diptera: Tephritidae) in Spain

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Abstract

The success of sterile males in area-wide sterile insect technique (aw-SIT) programs against *Ceratitis capitata* (Wiedemann) is currently measured by using indirect methods as the wild: sterile male ratio captured in monitoring traps. In the past decade, molecular techniques have been used to improve these methods. The development of a polymerase chain reaction-restriction fragment-length polymorphism-based method to identify the transfer of sterile sperm to wild females, the target of SIT, was considered a significant step in this direction. This method relies on identification of sperm by detecting the presence of Y chromosomes in spermathecae DNA extract complemented by the identification of the genetic origin of this sperm: Vienna-8 males or wild haplotype. However, the application of this protocol to aw-SIT programs is limited by handling time and personnel cost. The objective of this work was to obtain a high-throughput protocol to facilitate the routine measurement in a pest population of sterile sperm presence in wild females. The polymerase chain reaction-restriction fragment-length polymorphism markers previously developed were validated in Mediterranean fruit by samples collected from various locations worldwide. A laboratory protocol previously published was modified to allow for the analysis of more samples at the same time. Preservation methods and preservation times commonly used for Mediterranean fruit by female samples were assessed for their influence on the correct molecular detection of sterile sperm. This high-throughput methodology, as well as the results of sample management presented here, provide a robust, efficient, fast, and economical sterile sperm identification method ready to be used in all Mediterranean fruit by SIT programs.

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