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Long-Term Cold Acclimation Extends Survival Time at 0°C and Modifies the Metabolomic Profiles of the Larvae of the Fruit Fly *Drosophila melanogaster*

RNDr. Thesis

Mgr. Jaroslava Korbelová

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Annotation:

We assessed survival of larvae of the fruit fly, D*rosophila melanogaster* at 0°C after rearing them under three different acclimation regimes. A comparison of the larvae acclimated at constant 25°C with those acclimated at constant 15°C followed by constant 6°C for 2 d (15°C → 6°C) showed that long-term cold acclimation extended the lethal time for 50% of the population (Lt50) during exposure to constant 0°C as much as 630-fold (from 0.137 h to 86.658 h). Detailed metabolomic analyses showed that long-term cold acclimation modified the metabolomic profiles of the larvae. The most prominent responses were accumulations of proline (up to 17.7 mM) and trehalose (up to 36.5 mM). In addition, restructuring of the glycerophospholipid composition of biological membranes was observed.

Declaration [in Czech]:

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Jaroslava Korbelová

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Košťál V., Korbelová J., Rozsypal J., Zahradníčková H., Cimlová J., Tomčala A., Šimek P. 2011: Long-Term Cold Acclimation Extends Survival Time at 0°C and Modifies Profiles of the Larvae of the Fruit Fly *Drosophila melanogaster*. PLOS ONE September 2011: 1 – 10

Prohlašujeme, že se Jaroslava Korbelová podstatným způsobem podílela na výše uvedené publikaci.

prof. Ing. Vladimír Košťál, Csc.

Mgr. Jan Rozsypal

Ing. Helena Zahradníčková, PhD.

Long-Term Cold Acclimation Extends Survival Time at 0°C and Modifies the Metabolomic Profiles of the Larvae of the Fruit Fly *Drosophila melanogaster*

Vladimír Koštál[1]*, Jaroslava Korbelová[1], Jan Rozsypal[2], Helena Zahradníčková[1], Jana Cimlová[1], Aleš Tomčala[1], Petr Šimek[1]

1 Institute of Entomology, Biology Centre of the Academy of Sciences of the Czech Republic, České Budějovice, Czech Republic, **2** Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic

Abstract

Background: *Drosophila melanogaster* is a chill-susceptible insect. Previous studies on this fly focused on *acute* direct chilling injury during cold shock and showed that lower lethal temperature (LLT, approximately −5°C) exhibits relatively low plasticity and that acclimations, both rapid cold hardening (RCH) and long-term cold acclimation, shift the LLT by only a few degrees at the maximum.

Principal Findings: We found that long-term cold acclimation considerably improved cold tolerance in fully grown third-instar larvae of *D. melanogaster*. A comparison of the larvae acclimated at constant 25°C with those acclimated at constant 15°C followed by constant 6°C for 2 d (15°C→6°C) showed that long-term cold acclimation extended the lethal time for 50% of the population (Lt_{50}) during exposure to constant 0°C as much as 630-fold (from 0.137 h to 86.658 h). Such marked physiological plasticity in Lt_{50} (in contrast to LLT) suggested that *chronic* indirect chilling injury at 0°C differs from that caused by cold shock. Long-term cold acclimation modified the metabolomic profiles of the larvae. Accumulations of proline (up to 17.7 mM) and trehalose (up to 36.5 mM) were the two most prominent responses. In addition, restructuring of the glycerophospholipid composition of biological membranes was observed. The relative proportion of glycerophosphoethanolamines (especially those with linoleic acid at the *sn*-2 position) increased at the expense of glycerophosphocholines.

Conclusion: Third-instar larvae of *D. melanogaster* improved their cold tolerance in response to long-term cold acclimation and showed metabolic potential for the accumulation of proline and trehalose and for membrane restructuring.

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* E-mail: kostal@entu.cas.cz