Gradation of the acute stress response in rainbow trout exposed to stressors of different intensity

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Programme & Abstracts
Downstream signalling by adipokinetic hormone to counter oxidative stress in Drosophila melanogaster – Is FoxO involved?

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Forkhead box class O (FoxO) transcription factors are a family of conserved proteins that regulate the cellular response to various stimuli, such as energy deprivation, stress, as well as developmental cues. FoxO proteins are also important mediators of the response to oxidative stress (OS). In this study we present evidence that insect adipokinetic hormones (AKHs), which are pleiotropic neuropeptides involved in response to OS (in addition to their primary role in energy homeostasis) employ the FoxO transcription factor (dFoxO) to exert this effect in Drosophila melanogaster. Using the Gal4/UAS system several fly lines were generated: (1) with ablation of AKH cells (AKH-Gal4/UAS-rpr: AKH cell deficient- AKH-CD), (2) with AKH secretion deficiency (AKH-Gal4/UAS-Teix- AKH-SD), (3) with over-expression of AKH production (AKH-Gal4/UAS-AKH), and (4) the AKH-RNAi line. The response to acute exposure to either paraquat (20 mM) in 5% sucrose or 80 μM hydrogen peroxide (HP) revealed that flies overexpressing AKH had significantly less mortality than AKH-CD, AKH-SD, AKH-RNAi or the respective control lines (AKH-Gal4/+). Gene expression analysis followed by western blots revealed that AKH-RNAi flies had significantly less FoxO transcript and translated protein compared to flies overexpressing AKH when challenged with HP. Differential changes in expression of AMPK, TOR, PKA and Akt were also recorded among the genotypes tested in response to HP stress. The median lifespan of AKH over-expressing flies was greater than AKH-CD, AKH-SD, AKH-RNAi and comparable to the control (AKH-Gal4/+). Circadian locomotory activity rhythms revealed that flies over-expressing AKH sustained the strength of their rhythms even at day 35 compared to AKH-CD, AKO-SD and AKH-RNAi flies. Taken together, our data strongly suggest a role for dFoxO downstream of AKH as a transcription factor to mediate response to OS in D. melanogaster.

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After an intense acute stressor, fish develop a metabolic and behavioural stress response that usually lasts for several hours. Brain monoaminergic systems, in special the serotonergic system, seem to have a key role in the central regulation of the stress response. However, the relevance of the stressor intensity in the brain monoaminergic systems and in the induced stress responses is yet poorly understood. We hypothesized that serotonergic system could have a direct role in the integration of sensory information during stressor exposure and in the organization of the subsequent integrated stress responses. According to our hypothesis, lower stressor intensities would induce lower alterations in brain serotonergic system and therefore, stress responses of less intensity and duration. To test this, we exposed fish to handling disturbance for 5 s, 15 s or 3 min. After the beginning of the stress protocol, we sampled fish at 0 (controls), 3, 15, 45 and 240 min. Brain levels of serotonin, dopamine and their respective main oxidative metabolites 5-HIAA and DOPAC were analysed, along with plasma stress markers (catecholamines, cortisol, glucose and lactate). Regarding stress markers, the 5 s and 15 s stress protocols induced similar increases (in size and duration) on the serotonergic activity in all brain regions analysed (hypothalamus, telencephalon and medulla oblongata), independently of the duration of the handling disturbance, while the effects on dopaminergic system were minor and brain region-dependent. These data suggest that the brain serotonergic system, though likely involved in the recognition of the stressor stimuli, is not the only actor determining the intensity of the acute stress response in trout. Further studies would be required to investigate the participation of other neural pathways in that regulation.

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