Long-sought biomarker for chronic stress in fish discovered

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Johan Aerts (ILVO/Ghent University), under supervision of Prof. Dr. Sarah De Saeger (Ghent University), has discovered the long-sought biomarker for chronic stress in fish. Fish faced with stressful stimuli launch an endocrine stress response through activation of the hypothalamic-pituitary-interrenal (HPI-) axis to release cortisol into the blood. Plasma cortisol is a poor predictor for chronic stress as it reflects no more than a snap-shot of the stress response at a given moment.

On the contrary, the scale glucocorticoid, especially cortisol, content was shown to reflect the stress history of the fish. Elasmoid scales of teleostean fish are calcified dermal exoskeletal structures that grow along with the fish. The fish's scale captures systemic cortisol exposure over longer periods of time making it suitable to quantify chronic stress in fish. The adaptive value of short-term cortisol actions is widely recognized.

Far less is known about persistent stress and its mostly detrimental consequences for health, growth, and reproduction. This long-sought biomarker will help monitoring of general health of wild stock and developing a more sustainable aquaculture, secure fish performance in public aquaria and scientific research, and allow more in-depth stress physiological as well as bone physiological research.

Within the research of Johan Aerts (ILVO/Ghent University) on glucocorticoids as biomarker for acute and chronic stress across vertebrates, all in collaboration with Prof. Dr. Sarah De Saeger (Ghent

University), it was shown that glucocorticoids and especially cortisol in scales reflects the stress level experienced by fish in time making cortisol in scales of fish the long-sought biomarker to quantify chronic stress experienced by fish.

The pertinent literature lacks data on cortisol in a matrix that captures systemic cortisol exposure over longer periods of time suitable for chronic stress evaluation in fish, comparable to avian feathers and mammalian hair. Based on analyses of scales from highly relevant species for aquaculture such as common carp (Cyprinus carpio), gilthead sea bream (Sparus aurata), sea bass (Dicentrarchus labrax), Mozambique tilapia (Oreochromis mossambicus), Atlantic salmon (Salmo salar), rainbow trout (Oncorhynchus mykiss) and pike perch (Stizostedion lucioperca) as well as from fish commonly used in experimental studies such as zebrafish (Danio rerio), it was found that glucocorticoids, especially cortisol, incorporate in fish scales over time. An ultra-performance liquid chromatography tandem mass spectrometry (UPLC-MS/MS) quantification method for glucocorticoids in fish scales was developed in an EN ISO/IEC 17025 regulated environment and validated according the requirements of the Commission Decision No. 2002/657/EC.

In line with the predicted incorporation and accumulation of cortisol in scales over time an experimental trial with common carp, Mozambique tilapia, and zebrafish was performed in collaboration with Prof. Dr. Gert Flik and Dr. Juriaan Metz of the Department of Animal Physiology (Radboud University Nijmegen), and Prof. Dr. Annemie Decostere of the Department of Morphology(Ghent University). The scale cortisol content was biologically validated as biomarker for chronic stress as it provided a retrospective record of the stress response.

The innovative character of this biomarker for chronic stress is highlighted as it is subject of a patent application filed by ILVO/Ghent

University.