"Fish cell lines : a screening tool for multiple stress scenarios. Interaction between fatty acid profile and heavy metals in rainbow trout liver (RTL-W1)"

Bonnineau, Chloé ; Ferain, Aline ; Zuyderhoff, Alix ; Mc Gahan, Claire ; Pierloot, Marine ; Debier, Cathy ; Rees, Jean-François ; Larondelle, Yvan

Abstract
In aquatic ecosystems, environmental conditions (e.g. temperature, food quality, water quantity...) are seldom optimal and change overtime. Though these variations may affect organisms' capacity to cope with chemical contamination, they are rarely taken into account in classical ecotoxicological tests and most of the regulation on chemicals is based on single substance test performed under optimal conditions. Nevertheless, different environmental conditions (e.g. food quality) can modify the characteristics of an organism (e.g. nutritional status) and thus can influence both the entrance of chemicals within this organism and its ability to cope with it. In particular, in fish, fatty acid composition can modulate membrane fluidity and thus influence contaminant uptake. Due to their different antioxidant properties, fatty acids are also likely to influence cells' sensibility to oxidative stress induced by contaminants. Fish fatty acid profile is influenced strongly by nutrition and tem...

Document type : Communication à un colloque (Conference Paper)

Référence bibliographique
Bonnineau, Chloé ; Ferain, Aline ; Zuyderhoff, Alix ; Mc Gahan, Claire ; Pierloot, Marine ; et. al. Fish cell lines : a screening tool for multiple stress scenarios. Interaction between fatty acid profile and heavy metals in rainbow trout liver (RTL-W1).SETAC (Basel, du 11/05/2014 au 15/05/2014).

Available at:
http://hdl.handle.net/2078.1/154321
[Downloaded 2019/06/20 at 13:10:19]
Fish cell lines: a screening tool for multiple stress scenarios

Interaction between fatty acid profile and metals in rainbow trout hepatocytes (RTL-W1)

C. Bennineau, A. Ferain, I. Neefs, A. Zuyderhoff, C. McGahan, M. Pierlot, J.F. Roos, Y. Larondelle, C. Debler
Institut des Sciences de la Vie, UCLouvain, Louvain-la-Neuve, Belgium
chloe.bonnineau@uclouvain.be

MULTIPLE STRESS SCENARIO

In aquatic ecosystems, organisms undergo multiple stress due to environmental changes (temperature, food quality, water quality...) and contamination. Though classical toxicological tests usually investigate the effect of one pollutant under optimal and stable environmental conditions, the environmental parameters are likely to influence the response of organisms to contamination.

Food quality is expected to influence fish health and so its capacity to cope with stress. In particular, fish fatty acid (FA) profile is strongly dependent on fatty acid composition of its food. Since fatty acids play an important role in fish cell membrane, and in oxidative stress response, fatty acid composition may influence contaminant uptake and/or sensitivity to oxidative components such as metals.

=⇒ Is fatty acid composition of fish influencing metals toxicity in fish?

IN VITRO SCREENING

To be able to test the influence of various fatty acids on different metallic compounds, an in vitro study was conducted allowing to reduce complexity and focus on cause-effect determination.

1. Modification of cellular fatty acid profile
2. Cell characterisation after incubation with each fatty acid
3. For each fatty acid, determination of cells sensitivity to metals

Some FA influence cell response to metals

Medium FA composition influences the cellular FA profile

![Figure 1: FA composition (%) of phospholipids in control cells or in cells enriched in different FA](image1)

- Assimilation and incorporation of fatty acids from growth medium into the cells.
- Biotransformation of fatty acids by the cells: accumulation of some FA intermediates of the biosynthesis pathways of long chain FA.

No significant changes in cellular membrane fluidity

![Figure 2: Mean ± SE of coefficient of fluorescence anisotropy at 24h after 1 week incubation with one of the different FA tested or with no addition of FA (control). (n=6, except for DPA: n=2)](image2)

Membrane fluidity tends to be lower in cells enriched in omega-3 fatty acids than in cells enriched in omega-6 fatty acids and in control cells. Nevertheless, these results need further confirmation.

Few interactions between cell FA composition and response to metal exposure

- The fatty acid composition of the cell line RTL-W1 was successfully manipulated in vitro by modifying growth medium composition. Therefore, the cell model was particularly useful to screen different conditions and thus to investigate the interaction between nutritional stress and chemical contamination.

The influence of 6 fatty acids on cell response to 24h exposure to 3 different metallic compounds was investigated. Methymercury was found to be the most toxic compound, followed by mercury and cadmium. As shown by these first results, some fatty acids tested influenced cell viability. (estimated as membrane integrity), in response to metals contamination. In particular, the omega-6 fatty acid DPA may interact with mercury toxicity since DPA enriched cells were more sensitive to methymercury and presented a lower homestasis effect in response to inorganic mercury. Moreover, long chain highly unsaturated fatty acids in general may interact with inorganic mercury toxicity since a similar reduction of mercury homestasis was also observed in cells enriched in omega-3 fatty acid DHA. Finally, further investigation should be conducted on the potential protective effect of the omega-6 fatty acid LA against cadmium toxicity.

Omega-3 (n-3) FA: ALA, alpha-linolenic acid, EPA, eicosapentaenoic acid; DHA, docosahexaenoic acid
Omega-6 (n-6) FA: LA, linoleic acid; AA, arachidonic acid; DPA, docosapentaenoic acid

The research leading to these results has received funding from BEFSPD for the IAP JACQUOSTRESS (97/11), from the European Union Seventh Framework Programme (PIRST-2007-2013) under grant agreement PIR-GA 2012-232104 for FISHSTRESS project and from FNRS (A.Perain PhD grant: F315/S-ECI/ROI/BC-19727).

First author contact: Newcastle University, Department of Agriculture, Theology, and Veterinary Science, Newcastle, NE1 7RU, United Kingdom.