



HAL
open science

The dietary arachidonic acid content impacts the fatty acid metabolism, enzymatic and non-enzymatic metabolites of lipids and the response to acute stressor in rainbow trout fry

Emilien Segret, Cécile Heraud, Yann Marchand, Jérôme Roy, Claire Vigor, Battitte Sancho-Zubeldia, Camille Oger, Anaëlle Durbec, Jean-marie Galano, Thierry Durand, et al.

► To cite this version:

Emilien Segret, Cécile Heraud, Yann Marchand, Jérôme Roy, Claire Vigor, et al.. The dietary arachidonic acid content impacts the fatty acid metabolism, enzymatic and non-enzymatic metabolites of lipids and the response to acute stressor in rainbow trout fry. *Aquaculture Europe 2023 - Balanced Diversity in Aquaculture Development*, Sep 2023, Vienne, Austria. hal-04226070

HAL Id: hal-04226070

<https://hal.inrae.fr/hal-04226070>

Submitted on 3 Oct 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

THE DIETARY ARACHIDONIC ACID CONTENT IMPACTS THE FATTY ACID METABOLISM, ENZYMATIC AND NON-ENZYMATIC METABOLITES OF LIPIDS AND THE RESPONSE TO ACUTE STRESSOR IN RAINBOW TROUT FRY

Emilien Segret³, Cécile Heraud², Yann Marchand⁴, Jerome Roy², Claire Vigor⁵, Battitte Sancho-Zubeldia³, Camille Oger⁵, Anaëlle Durbec⁶, Jean-Marie Galano⁵, Thierry Durand⁵, Geneviève Corraze², Yoann Cachelou¹, Frederic Cachelou³, Sandrine Skiba-Cassy², Emilie Cardona^{1,2*}

¹Viviers de Rébénacq, 64260 Rébénacq, France

²INRAE, Univ. Pau & Pays Adour, E2S UPPA, UMR 1419 NuMeA Nutrition, Metabolism and Aquaculture, 64310 Saint Pée-sur-Nivelle, France

³Viviers de Sarrance, 64490 Sarrance, France

⁴Legouessant Aquaculture, 22402 Lamballe, France

⁵Institut des Biomolécules Max Mousseron (IBMM), CNRS UMR5247, Université de Montpellier, ENSCM, Montpellier, France

⁶MetaToul-Lipidomique, I2MC,1048, Inserm, 31432 Toulouse, France

Corresponding author: emilie.cardona@inrae.fr

Introduction

The importance of arachidonic acid (20:4n-6, ARA) in fish nutrition is receiving increasing attention. Indeed, this fatty acid (FA) plays a crucial role in growth, survival, stress resistance, and immunity in fish (Bell and Sargent, 2003). Freshwater fish are capable of synthesizing ARA from linoleic acid (LA, 18:2n-6), unlike marine species, which have a reduced ability. The endogenous capacity of freshwater fish to synthesize polyunsaturated fatty acids (PUFAs) and thus ARA differs between species. The ARA requirements of rainbow trout have not yet been determined. Therefore, the objective of the present study was to evaluate the consequences of variable dietary ARA intake on survival, growth but also PUFAs biosynthetic capacity and stress response in rainbow trout fry.

Materials & methods

For this purpose, rainbow trout fry were fed diets containing different proportions of ARA (*i.e.* 0.6, 1.1 or 2.5% of total FA) for 8 weeks and survival and growth were monitored during the whole duration of the trial. At the end of the experiment, fish were exposed to acute confinement (10 min at 10 kg/m³) to evaluate stress response. Whole fish were collected to investigate the effects of diets on (1) endogenous biosynthesis of PUFAs, (2) production of FA oxidation-derived compounds, and (3) stress response through serotonin (5-HT) and dopamine (DA) pathways by monitoring 5-HT/5-HIAA ratios (target/one metabolite of 5-HT) and L-DOPA/HVA ratios (direct precursor of DA/one metabolite of DA).

Results & discussion

The ARA diet level did not affect the growth, but the lowest level of ARA significantly increased mortality, although the percentage of mortality was very low (1.6% for the ARA0.6 diet compared to 0.7% for the other diets, *p*-value=0.01). This ARA0.6 diet also showed a significantly higher level of expression of fatty acid elongase 5 (*elovl5*). This enzyme converts, in particular, LA to ARA, suggesting that rainbow trout can synthesize ARA from LA when dietary supply of ARA is low.

Oxylipins are bioactive lipids generated by the oxidation of PUFAs. Those derived from ARA, such as prostaglandin D2 and E2, are considered to be pro-inflammatory and may, in excess, be harmful to fish (Bell and Tocher, 2009). Omega-3 (ω 3 or n-3). When fingerlings were fed the diet containing the highest level of ARA (2.5% of total FA), the production of oxylipins derived from ARA significantly increased while that of oxylipins derived from other PUFAs, such as eicosapentaenoic acid (20:5n-3, EPA), docosahexaenoic acid (22:6n-3, DHA), LA, and α -linolenic acid (ALA 18:3n-3) were not altered.

The serotonergic and dopaminergic activities resulting from stress revealed a more effective response when the ARA content of the diet was 1.1% of the total FA. This was evidenced by higher 5-HT/5-HIAA and L-DOPA/HVA ratios with the ARA1.1 diet than with the other two diets. These results indicated that the ARA content of the diet can modulate the response of the fish to an acute confinement stress.

(Continued on next page)

Conclusion

In conclusion, a dietary intake of ARA corresponding to 1.1% of total FA seems to be the most appropriate to promote the robustness of rainbow trout fry. Indeed, with an ARA intake of only 0.6% of the total FA, survival decreases even though the capacity to synthesize ARA from its precursor LA increases. With an ARA level of 2.5% of the total FAs, the production of ARA-derived oxylipins rises, which could ultimately have negative effects on the health of the fish.

References

- Bell JG, Sargent JR. Arachidonic acid in aquaculture feeds: Current status and future opportunities. *Aquaculture* 2003;218:491–9. [https://doi.org/10.1016/S0044-8486\(02\)00370-8](https://doi.org/10.1016/S0044-8486(02)00370-8).
- Bell M V., Tocher DR. Biosynthesis of polyunsaturated fatty acids in aquatic ecosystems: General pathways and new directions. *Lipids Aquat. Ecosyst.*, vol. 9780387893662, Springer New York; 2009, p. 211–36. https://doi.org/10.1007/978-0-387-89366-2_9.

Acknowledgements

This study is funded by the Nouvelle-Aquitaine Region (French local authorities).