# 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

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# 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

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## 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, harmful to fish (Bell and Tocher, 2009)omega-3 (ω3 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 serotoninergic 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.

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**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**

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