Impact of supplementation of micro algae Schizochytrium sp., in plant diet on reproduction of female rainbow trout (Oncorhynchus mykiss) and consequences on progeny

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IMPACT OF SUPPLEMENTATION OF MICRO ALGAE *Schizochytrium sp.,* IN PLANT DIET ON REPRODUCTION OF FEMALE RAINBOW TROUT (*Oncorhynchus mykiss*) AND CONSEQUENCES ON PROGENY

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Introduction

In the last years, the increase in aquaculture production has forced a change in fish feed composition, with increasing substitution of fish meal (FM) and fish oil (FO) by more available plant sources. Despite the fact that their inclusion rates in compound feeds for aquaculture have shown a clear downward trend in the twenty past years (FAO, 2018), their total replacement by plant feedstuff is still not optimal, leading to reduced growth and reproductive performance (Lazzarotto et al., 2015)no whole breeding cycles of fish fed diets free from marine resources has been reported to date. We therefore studied the reproductive performance of trout after a complete cycle of breeding while consuming a diet totally devoid of marine ingredients and thus of n-3 long chain polyunsaturated fatty acids (n-3 LC-PUFAs.

The broodstock diet, and in particular the lipid and fatty acid composition of the diet, is known to play a key role in reproductive efficiency and survival of the progeny (Izquierdo et al., 2001). And a major problem when replacing both FM and FO by plant sources is the lack of n-3 long chain polyunsaturated fatty acids (n-3 LC-PUFAs), such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).

Materials & methods

For that purpose, we studied the effect, in rainbow trout female broodstock, of the plant diet supplemented with microalgae (MA) compared to a conventional commercial diet rich in FM and FO (C) on a reproductive performance and egg quality. The microalgae *Schizochytrium sp.,* chosen to supplement plant-based diet in this study, is known to be a rich source of DHA. An 18 months trial involving two reproductive cycles was carried out. During two spawning seasons, we followed the performance of female reproduction measuring fecundity and egg quality. We also investigated the consequences of maternal nutritional history on offspring after the second spawning season. Experimental design is presented in figure 1.

Results & discussion

Despite a significantly lower growth rate in female fed MA diet, the reproductive performances were not affected (egg weight, absolute fecundity). Moreover, in terms of egg quality, during the second cycle of reproduction, the egg diameter was significantly lower with the MA diet, but the eggs presented a significant better egg integrity (less white eggs after 24 hours of hydration) than with a C diet, which is a sign of a better egg quality. Regarding embryonic development, eggs from females fed MA diet had significantly higher hatching survival rate than eggs from females fed C diet. No effect was observed on fry weight at resorption. We linked this better egg quality to a better-balanced fatty acid profile.

Moreover, feeding female with the MA diet had no effect on the growth and survival of the progeny compared to feeding with C diet. However, consequences of maternal nutritional history were observed in the lipid metabolism of progeny. Progeny from female fed MA diet had increased fatty acid biosynthesis and cholesterol synthesis metabolisms. Genes involved in these metabolisms were up-regulated in progeny from female fed MA diet compared to progeny from female fed C diet, whether challenged with an MA diet or fed a commercial diet (figure 2).

Conclusion

To conclude, in the present study, we demonstrated that DHA-rich microalgae supplementation in a plant-based diet allowed to maintain reproductive performance and egg quality comparable to a conventional commercial feed rich in FM and FO. Moreover, this study confirms a reprogramming of the lipid metabolism of progeny in relation to the origin of maternal nutritional.

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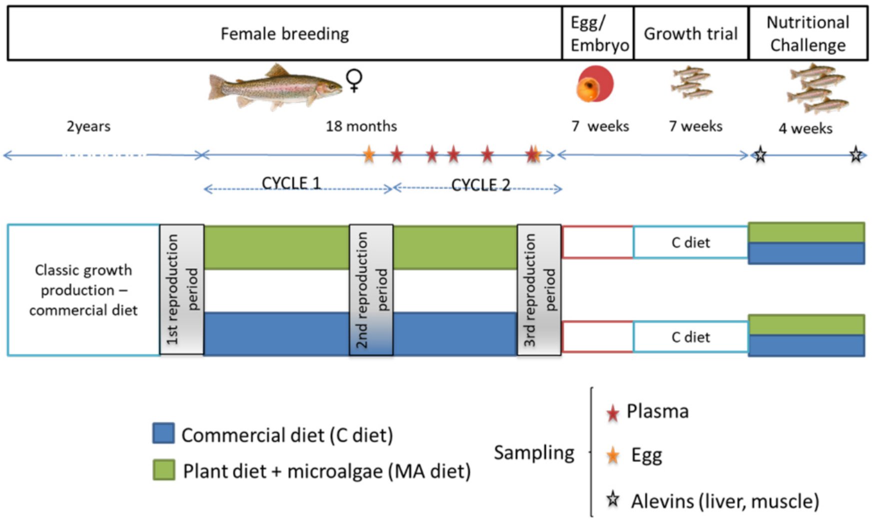

Figure 1 : Experimental design

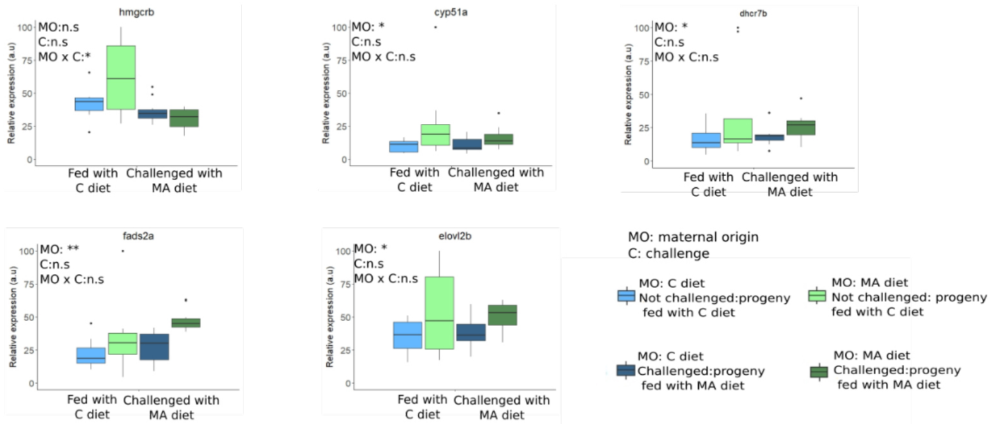

Figure 2:Relative expression of genes involved in fatty acid biosynthesis (elovl2b : fatty acid elongase2 and fads2a : fatty acid desaturase 2) and in cholesterol biosynthesis (hmgcrb : 3-hydroxy-3-methylglutaryl-CoA reductase ; cyp51a : lanosterol 14alpha-demethylase and dhcr7b : 7-dehydrosterol reductase) of progeny according maternal origin in response to a nutritional challenge (fed with C diet or challenged with MA diet).

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