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25. The INRA team « Growth and Flesh Quality » : From study of muscle tissues to flesh quality determinisms in fish

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In the context of world population expansion, the need for animal proteins, particularly fish proteins, is increasing and will continue to increase worldwide in the future. With the decline of wild stocks and commercial fishing, sustainable aquaculture development is one of the main challenges to support fish consumption and food safety. Muscle constitutes the edible part of the fish and it composes up to 60% of the body weight, highlighting the importance of its development for the competitiveness of aquaculture. Fish of agronomic interest have the extraordinary ability to exhibit a continuous muscle growth associated with the persistent formation of new myofibres (hyperplasia) during the post-larval exponential growth phase. Therefore, the intensity and the duration of the post-larval hyperplastic growth is crucial for the muscle growth potential of fish. In addition to the quantitative aspect of muscle production, some aspects of the flesh quality, such as the texture, are directly dependent on the relative part of muscle tissues. The aim of the “Growth and Flesh Quality” team is to understand the mechanisms of development and muscle tissue growth for improving the production and the quality of flesh. Our research are based on cutting edge technologies (transcriptome, transgenesis, gene knockdown, CrispR/Cas9 gene inactivation) as well as applied technologies for flesh quality analyses (texture, filet yield prediction).

Using an Agilent-based microarray, we recently carried out a time-course analysis of transcript expression during muscle regeneration [1]. This analysis shows a coordinated expression of functionally related genes in trout. Among them, a large set of genes was previously reported to be up-regulated in hyperplastic muscle growth areas, indicating that many features of the transcriptional program underlying muscle hyperplasia are reactivated when new myofibres are transiently produced during fish muscle regeneration.

Given the importance of miRNA in myogenesis, we performed a high throughput analysis and produced a repertoire of trout miRNA (Juanchich *et al.*, 2016). To identify new miRNA potentially involved in satellite cell differentiation, we used a methionine depletion/replenishment protocol to synchronize myogenic cell differentiation *in vitro* following by a microarray analysis [2]. Our results show that miR-133a and miR-210 had strong expression in white muscle. We also showed that miR-210 expression was upregulated during differentiation of satellite cells, suggesting that miR-210 was involved in the differentiation of satellite cells.

Among the flesh quality parameters, we are particular interested in texture. By comparing the transcriptome of trout muscle with firm or soft texture, we identified several markers correlated with flesh texture. We also confirmed that some of these markers are also relevant in several experimentations.

The control of slaughter stress is of importance with regard to both fish welfare and flesh quality. Muscle characteristics and instrumentally measured quality parameters were determined in rainbow trout lines selected for high-responsiveness (HR) or low-responsiveness (LR) of plasma cortisol to an acute confinement stressor [3]. Our results show that genetic selection for low stress responsiveness does not appear to offer benefits to manage slaughter-stress consequences on flesh quality.

Selection to improve processing yields relies on sib selection, in which live candidates are ranked according to their family breeding value. This approach limits genetic progress, as it only exploits genetic variability between families and not within them. Indirect criteria measured on live candidates could overcome this limitation. Thus, we developed in trout morphometric analyses by external measures combined in a linear regression model, that allow the prediction of phenotypic processing yields [4].

Conclusion

The “Growth and Flesh Quality” team gathers expertises and knowledges in key scientific areas for integrating the impact of nutrition and environment on muscle growth and flesh quality in fish.

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Workshop Proceedings

Importance of nutrition and environment on birth weight, muscle growth, health and survival of the neonate

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