



Effects of dietary protein level and non-protein energy source on muscle growth mechanisms in rainbow trout (*Oncorhynchus mykiss*) juveniles

Dr. Hélène Alami-Durante INRA, UPPA, UMR 1419 Nutrition Metabolism Aquaculture **Ms. Marianne Cluzeaud** (1)

Mr. Didier Bazin (1) **Dr. Johan Schrama**

Aquaculture and Fisheries Group, Wageningen Univ. Dr. Subramanian Saravanan *Aquaculture and Fisheries Group, Wageningen Univ. Dr. Inge Geurden* (1)

Muscle growth, the main determinant of fish growth, is the result of two mechanisms: hyperplasia (recruitment of new muscle fibres) and hypertrophy (growth of existing fibres). The regulation of fish muscle hyperplasia and hypertrophy by changes in dietary macronutrient composition has been little documented. This study analyses the effects of dietary digestible protein to digestible energy (DP/DE) ratio and non-protein energy (NPE) source on muscle growth mechanisms in rainbow trout juveniles by using cellular and molecular approaches. The four diets had identical DE levels with a high vs. low DP/DE ratio using 'F, fat' or 'C, carbohydrate' as major NPE (HP/EF, HP/EC, LP/EF, LP/EC). They were fed to rainbow trout juveniles for 7 weeks. At high DP/DE ratio, the protein growth was unaffected by NPE source. At low DP/DE ratio, protein growth was higher when NPE source was fat. Compared to control (HP/EF), the gene expression of MyoD1 and Mrf4 was increased in LP/EF-juveniles, that of CathD increased in HP/EC-juveniles, and that of fMHC and fMLC2 decreased in LP/EC-juveniles. A lowering of DP/DE ratio decreased the gene expression of Mstn1b whatever the NPE source. Feeding the HP/EF-diet led to the highest total cross-sectional area of white muscle (TCSAWM) and total number of white muscle fibres (TNWF). Both were decreased, for each DP/DE ratio when NPE was carbohydrate, and for each NPE source when DP/DE ratio was low. The LP/EC-trout had the lowest TCSAWM and TNWF. Changes in diet composition also induced changes in white fibre growth dynamics. At high DP/DE ratio, the replacement of fat by carbohydrate decreased the percentage of small fibres and the maximum fibre diameter. At low DP/DE ratio, the replacement of fat by carbohydrate had no effect on the percentage of small muscle fibres but decreased the maximum diameter of muscle fibres and the percentage of large fibres. Our data thus indicate that a combination of low DP/DE ratio and carbohydrates as NPE strongly impairs white muscle growth, due to decreased hyperplasia and hypertrophy, while a combination of high DP/DE ratio and fat as NPE stimulates both hyperplasia and hypertrophy, leading to high muscle growth.