EPIGENETIC REGULATION OF MUSCLE GROWTH BY TEMPERATURE IN SENEGALESE SOLE (*SOLEA SENEGALENSIS*)

Campos, C.[1,2,3], Valente, L.M.P.[2], Conceição, L.E.C.[3,4], Engrola, S.[3], Fernandes, J.M.O.[1]

[1]Faculty of Biosciences and Aquaculture, University of Nordland, Norway; [2]CIIMAR/CIMAR, Centro Interdisciplinar de Investigação Marinha e Ambiental and ICBAS–Instituto de Ciências Biomédicas de Abel Salazar, Universidade do Porto, Portugal; [3]CCMAR/CIMAR, Centro de Ciências do Mar; Universidade do Algarve; Campus de Gambelas; Faro, Portugal;[4] SPAROS Lda; Area Empresarial de Marim; Olhão, Portugal

E-mail: Jorge.fernandes@uin.no

SUMMARY

Several commercial fish species display a remarkable phenotypic plasticity of muscle growth that is influenced by environmental temperature, especially during early ontogeny stages. It is known that water temperature can significantly influence the number and size of muscle fibres by regulating cell rates of hypertrophy and hyperplasia but the molecular networks underlying this plasticity are poorly understood. DNA methylation of specific cytosine residues in the genome is one of the main epigenetic mechanisms regulating gene expression. In the present study, Senegalese sole (*Solea senegalensis*) eggs were incubated at 20 °C until hatching and then larvae were transferred to triplicate tanks at three different temperatures (15 °C, 18 °C or 21 °C). Rearing temperature significantly affected dry weight and total length of Senegalese sole larvae at stage 2 of metamorphosis. Larvae reared at 21 °C had larger muscle fibres and a mean weight 2-fold greater than their counterparts from the 15 °C group. Transcript levels of several growth-related genes, including *myogenin* (*myog*), were affected by rearing temperature. This key myogenic gene encodes a highly conserved myogenic regulatory factor that is involved in terminal muscle differentiation. *Myog* expression was down-regulated by almost 50% in larvae reared at 15 °C compared to 21 °C, which could explain, at least in part, the observed growth difference between the two temperature groups. The lower levels of *myog* transcripts at 15°C may be due to cytosine methylation of its promoter in skeletal muscle. Indeed, we observed increased *myog* promoter methylation at 15°C, particularly at specific CpG sites, relatively to higher rearing temperatures (Fig. 1). We are currently using next-generation sequencing to obtain a global perspective of the different layers involved in epigenetic regulation of muscle growth by temperature, with focus on miRNAs.

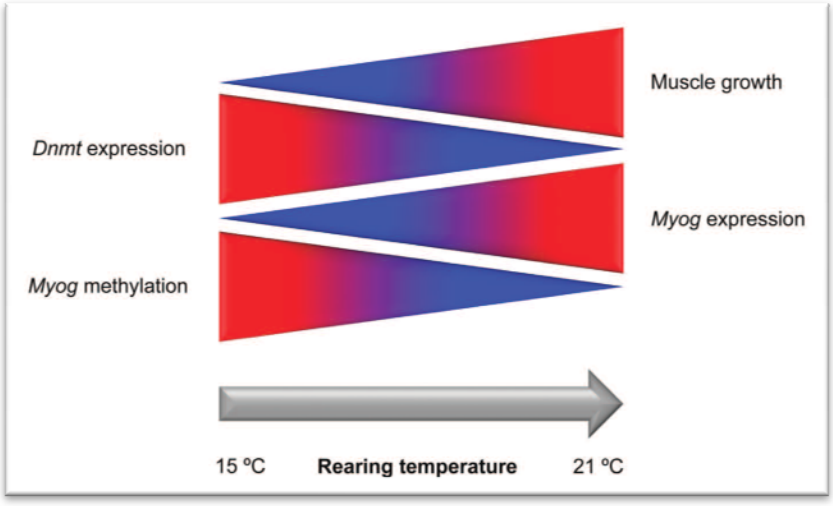

Figure 1. Simplified model of thermal phenotypic plasticity of muscle growth in Senegalese sole larvae (from Campos *et al.*, 2013b).

Keywords: Thermal plasticity, *myogenin*, methylation, epigenetic regulation, myogenesis.

Acknowledgements
This work was funded by research grants EPISOLE-PTDC/MAR/110547/2009, SFRH/BD/43633/2008 and SFRH/BPD/49051/2008 from the Fundação para a Ciência e a Tecnologia (Portugal) and Programa Operacional Temático Factores de Competitividade (COMPETE), FEDER, with additional support from the Research Council of Norway (grant 190350/S40).

References

Campos C., Fernandes J.M.O., Conceição L.E.C., Engrola S., Sousa V. & Valente L.M.P. Thermal conditions during larval pelagic phase influence subsequent somatic growth of Senegalese sole by modulating gene expression and muscle growth dynamics (2013a). *Aquaculture* 414–415: 46–55.

Campos C., Valente L.M.P., Conceição L., Engrola S. & Fernandes J.M.O. (2013b). Temperature affects methylation of the myogenin putative promoter, its expression and muscle cellularity in Senegalese sole larvae. *Epigenetics* 8: 389-397.