EARLY LIFE MANAGEMENT PROTOCOL FOR OPTIMAL PERFORMANCE OF SEA BREAM


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SUMMARY

This OUTPUT is an early life management protocol of O_2 (oxygen) concentration levels in the aquatic environment of gilthead sea bream (*Sparus aurata*). The protocol is an improved management tool that will help to rear more robust sea bream. This fish species was shown to exhibit a high metabolic plasticity to cope with changes in O_2 concentrations. Moreover, gilthead sea bream demonstrated higher larval survival and improved metabolic performance later in life after exposure to low O_2 concentrations during a specific window of development (60-80 days post-hatching). This protocol will assist fish farmers and researchers to improve their fish management and research results during the production cycle.

KNOWLEDGE NEED

How fish are managed during early life stages affects their health and performance in later years. Therefore, good early life management of environmental factors, including O_2 concentration, is highly important to fully exploit productive traits of farmed fish. A progressive decline in O_2 concentration causes hypoxia, a condition in which fish are deprived of adequate O_2 supply at tissue level. To ensure that the physiological function of fish is not compromised, and to guarantee their welfare, changes in O_2 concentrations should be considered and well-regulated in aquaculture systems, exploiting also the potential benefits of hypoxia pre-conditioning at specific stages of the life cycle.


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POTENTIAL IMPACT

- Applying this protocol will result in more robust and healthier sea bream at later stages in life, resulting in increased profits for sea bream farmers.
- Using a protocol to produce robust and healthy fish will result in higher quality and more efficient scientific experiments, leading to improved animal welfare and aquaculture profitability.
- Developing a protocol for O_2 supply during early life management can bring a uniform approach to managing fish across the aquaculture industry which would benefit both quality and welfare standards. Development of similar protocols for other fish species should be studied.

EATiP - Strategic Research and Innovation Agenda (SRIA) Thematic Area 2 – Technology & Systems; Goal 3, Thematic Area 6 – Knowledge Management; Goal 1, Thematic Area 7 – Aquatic Animal Health and Welfare; Goal 3. To see the full list and descriptions of the thematic areas and goals, please visit: **eatip.eu/?page_id=46**

UNDERLYING SCIENCE

Acute and mild hypoxia was induced in sea bream juveniles to assess the resilience of this farmed fish to acute and chronic hypoxia exposure at different rearing densities. The impact of hypoxia pre-conditioning was assessed at the level of blood, tissue and whole organism by means of swimming tests and haematological, hormonal, and wide and targeted transcriptional analysis. Additional hypoxia challenges were conducted during early life stages to test the hypothesis that reduced O_2 levels at specific stages of development can assist fish farmers to improve fish management later in life through the involvement of epigenetic mechanisms.

RESULTS

- Blood physiological hallmarks demonstrate the enhancement of O_2-carrying capacity in addition to a reduced but more efficient aerobic energy production in juvenile fish exposed to acute hypoxia.
- Transcriptional analyses disclose the different contributions of liver, heart, muscle and blood to mild hypoxia and crowding stress responses in sea bream.
- Hypoxia pre-conditioning during juvenile stages allows improved swimming and metabolic performance at reduced O_2 concentration levels.
- Metabolic effects of hypoxia pre-conditioning during early life stages (60-80 days post-hatching) are more persistent than the effects resulting from hypoxia pre-conditioning during later life.
- The early life O_2 management protocol improves survival rates as well as growth and swimming performance of hypoxia-challenged fish later in life.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Marine biologists, aquaculture and biotechnology scientists

APPLICATION: Applying the protocol to better track growth potentiality and size heterogeneity of sea bream.

END-USER 2: Farmers of gilthead sea bream

APPLICATION: The protocol is an improved management tool that will help to rear more robust sea bream, thereby supporting individual fish welfare and profitability of the sea bream aquaculture industry.

STATUS

Technology Readiness Level (TRL) 4- the knowledge has been validated in a laboratory environment.

Further research is needed to:

- Check and refine the tested protocol for different sea bream strains and culture conditions.
- Determine how long metabolic priming lasts over the course of the production cycle, assisting farmers to produce robust, healthy and high quality fish.

AT A GLANCE

TITLE: Early Life Management Protocol for Optimal Performance of Sea Bream

KNOWLEDGE TYPE: Guidelines/standards

WHERE TO FIND IT: Martos-Sitcha et al. (2017). Gene expression profiling of whole blood cells supports a more efficient mitochondrial respiration in hypoxia-challenged gilthead sea bream (*Sparus aurata*). Frontiers in Zoology 14, 34. DOI 10.1186/s12983-017-0220-2; Martos-Sitcha et al. (2019). Tissue-Specific Orchestration of Gilthead Sea Bream Resilience to Hypoxia and High Stocking Density. Front Physiol 10, 840. DOI 10.3389/fphys.2019.00840

STATUS: Additional articles will be published in 2020

FACILITY USED: Consejo Superior de Investigaciones Científicas (IATS-CSIC), Spain

CONTACT DETAILS: Jaume Pérez-Sánchez, CSIC, Spain; jaime.perez.sanchez@csic.es; Josep Calduch-Giner, CSIC, Spain; j.calduch@csic.es

PATENTS OR OTHER IPR EXPLOITATIONS: No