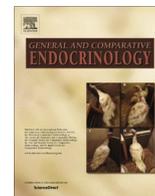




Contents lists available at ScienceDirect

General and Comparative Endocrinology

journal homepage: www.elsevier.com/locate/ygcen

Research paper

Multifactorial analyses revealed optimal aquaculture modalities improving husbandry fitness without clear effect on stress and immune status of pikeperch *Sander lucioperca*

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ARTICLE INFO

Article history:

Received 28 April 2017

Revised 18 July 2017

Accepted 10 August 2017

Available online xxx

Keywords:

Brain neurotransmitters

Stress

Innate immunity

Pikeperch

Fractional factorial design

ABSTRACT

High mortality and impairment in growth rate during pikeperch (*Sander lucioperca*) on-growing are among the major bottlenecks for its development in aquaculture. These failures may be related to high stress responsiveness since the rearing conditions are not yet optimized for this species. The objectives were to characterize the stress and immunological responses of pikeperch to major aquaculture modalities, and to identify the optimal aquaculture conditions for improving its welfare status. In a screening experiment, eight factors considered as relevant for the welfare of pikeperch were compared in two modalities using a fractional multifactorial design (2^{8-4}). Each experimental unit represented a combination of 8 factors in two modalities including grading, stocking density (15 vs 30 kg·m⁻³), feed type (sinking vs mid-floating), light intensity (10 vs 100 lux), light spectrum (red vs white), photoperiod (long vs short), dissolved oxygen (60 vs 90%) and temperature (21 vs 26 °C). Fish sampling occurred on days 36 and 63. Stress markers (glucose, cortisol and brain serotonergic activity), innate immune parameters (plasma lysozyme and complement activities) and expression of some immune genes were assessed. Light intensity and the type of feed clearly appeared as directive factors for pikeperch culture. A strong effect of the feed type was observed on growth parameters while survival was impacted by high light intensity. Light characteristics (intensity, spectrum and photoperiod) and temperature were identified as determining factors for physiological and immune markers. No obvious relation was established between stress status and growth parameters and further investigations are needed to improve management strategies of pikeperch culture and knowledge on the relations between environmental conditions, stress and immunity in percid fish.

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1. Introduction

Over the last decade, European inland aquaculture has shown weak increase in productivity despite the increase in the demand for fish products throughout the world (FAO, 2014). This low performance in fish production might be attributed to the low number of fish species that are cultivated in Europe. Indeed, European aquaculture is mainly focused on 5 fish species: Atlantic salmon (*Salmo salar*), rainbow trout (*Oncorhynchus mykiss*), common carp (*Cyprinus carpio*), European seabass (*Dicentrarchus labrax*) and gilt-head seabream (*Sparus aurata*). Therefore, it is essential to diversify

the fish species pool in order to increase fish productivity throughout Europe and to tap into new niche markets. Pikeperch (*Sander lucioperca*) is one of the most promising freshwater fish species for diversification and an attractive alternative for inland aquaculture species according to its relatively fast growth compared to other, its high quality flesh and a favorable market acceptance leading to high economical expectations species (Hilge and Steffens, 1996; Barry and Malison, 2004; Wang et al., 2009; Dalsgaard et al., 2013).

However, the culture of pikeperch is still limited by an unpredictable high mortality rate and impairment in growth rate during both larval and juvenile stages with survival rate estimated between 8 and 30% (Kestemont et al., 2007; Szkudlarek and Zakes, 2007; Dalsgaard et al., 2013). A low welfare related to high

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