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Enlightenments to a Model of Humoral and Cellular Effects of Stress

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ABSTRACT

The continued existence of the aquaculture industry depends on its profitability. Stress is considered a primary factor contributing to impaired health in cultured fish. Studying the influence of stress on the immune system can suggest tools to handle sensitivity to the morbidity and mortality of fish in fish ponds. This article supplies guidelines on how to isolate the factors down regulating the immune system following stress. Analyzing the varied components of the immune system highlighted the influence of chronic stress on the down regulation of cytotoxic components.

INTRODUCTION

Aquaculture conditions are often exposed to various stressors, such as the invasion of predatory birds, seasonal fluctuations in temperature, and variable environmental pollutants that increase fish sensitivity and expose them to various pathogens, resulting in high morbidity and mortality that influence the feasibility of the fishery industry. Stress influences humoral and cellular immune systems that are regulated by the nervous and endocrine systems via cytokines, hormones, neurotransmitters and receptors, which are in constant communication. Stress was widely studied in mammals and less in fish, but several studies on fish support the stress mechanism as reported in mammals [1].

Stressors might have profound positive or negative effects on the immune system, depending on the duration, intensity, and type of stressor. The aim of this study was to distinguish and isolate the main causes of the developing imbalance of the immune system that lead to the increase of morbidity [2].

RESEARCH METHODOLOGY

The authors assumed that in order to increase the profitability of the aquaculture industry, we have to improve the welfare and reduce the morbidity of the fish. Stress seems to be the main cause of the increased sensitivity to diseases and mortality in fish, therefore, it was important to:

1) Determine the type of stress down regulating the immune system function.
2) Classify the immune components to cells and constituents of main functions in the immune system.
3) Examine and analyse the functions that are mostly influenced by stress.
4) Focus the study on the most influenced functions [2].

In accordance with these principals, immune cells were grouped into small and large lymphocytes, polymorphonuclear cells, and monocytes/macrophages. Their levels were measured by flow cytometry during stress treatments.

Similarly, the immune components were classified to:

1) CD4 and CD8α cells, which represent the majority of cells involved in immune processes.
2) Significant agents of the innate immunity (IgM and the complement C3).
3) Pro-inflammatory cytokines IL1β, IL6 and TNFα.
4) Inflammatory cytokines related to Th1 cells (IFNγ2b and IL12β) and Th17 cells (IL17).
5) Regulatory cell cytokines, such as IL10, TGFβ and FoxP3.
6) Chemoattractant CXCL8, which acts similarly to the mammalian IL8 in mobilizing macrophages/neutrophils/leukocytes to the target area.

Their mRNA levels were measured by real-time qPCR [2].

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THEORETICAL VALUE OF THE ARTICLE

The above-mentioned guidelines enabled us to differentiate between the different types of stress, and focus on the detrimental effects of chronic stress on the immune system. Moreover, these guidelines enabled us to determine the severity of the influence of chronic stress on immune components and differentiate between: (1) unchanged influence on components' mRNA levels, such as on the innate system (IgM, C3s) and pro-inflammatory cytokines (IL6, TNFα); (2) fluctuating influence, in which chronic stress temporarily changed mRNA levels of immune components, such as regulatory cytokines (IL10, TGFβ, FoxP3), pro-inflammatory cytokines (IL1β, IL17), and CD8 cells; and (3) prominent effects on the decline to null levels, e.g of IFNγ and IL12β. The severe decline of IFNγ and IL12β focused the study on their decrease. The authors did not impose the responsibility for that decline of IFNγ and IL12β only on Th1 cells because in carp, there are additional cells that prominently produce IFNγ, such as γ/δT, NK and MR1 cells. Therefore, the following study also emphasized the sharp decline of additional cytotoxic metabolites such as FasL, granzyme, NK lysin and Tbet mRNA versus minor changes in cell levels [3]. These findings focus on the detrimental influence of chronic stress on the metabolism of cytotoxic cytokines, which leads to unresponsiveness to pathogens and unwanted cells.

CONCLUSION

This article highlights the need to isolate the main type of stress sharply down regulating the immune system as well as to determine the most affected factor in the immune system. The above findings enable us to improve the well-being and growth of fish in the ponds.

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