

The animal/fish farming industry faces a significant growth and therefore also faces the enormous challenge to develop into a reliable provider of healthy environmental-friendly food. The aquatic milieu is characterized by a high pathogen density and, like mammals, fish have developed an efficient immune defense to prevent- and to cope with infection. Like in mammals, also in fish the immune response is of primary and crucial importance and is based on tightly regulated immune cell (leukocyte) migration to the site of infection. This process is regulated by release of chemokines from leukocytes and detection of these signaling molecules by their specific receptors on the target cells. Interestingly, beyond immune regulation, chemokines are also involved in the regulation of the stress response. In the conventional perception, the stress hormones (corticoids) have anti-inflammatory properties. However, in human beings and in animals, including fish, stress induces an increase of the number of specific leukocyte populations (neutrophils) in the blood circulation. Neutrophils are the first cells of the immune response migrating to the site of infection, to form an effective first line of defense to pathogen invasion. But this considerable activation of the inflammatory process poses a serious challenge to patients suffering from (autoimmune) diseases that are characterized by unwanted immune activity. For instance, in patients suffering from Cushings disease, high levels of stress hormones are associated with poor outcome of treatment and with excessive amplification of the immune response. This phenomenon of deregulation of the immune response is evolutionary conserved and also occurs in fish. This is currently of prime importance since for the future growth of the aquaculture industry, a substantial gain in productivity is essential and can only be achieved by a solid control of the stress responses and infectious diseases.

The process of regulation of neutrophil migration in circumstances of stress is still largely unknown. Therefore, in the present project we aim to study the effects of stress on the migration and activity of neutrophils and on the production and release of factors regulating this neutrophil migration and their ability to kill pathogens. In detail, we will study the role of chemokines and of the microbiome in the stress-induced changes in the number of neutrophils and in their activity. Moreover, upon challenging conditions of stress, we will follow the path of neutrophils from their place of origin to the infection site or to the place of their death.

We will use two fish species: carp and zebrafish. Carp is an economically important fish species since it is one of the most cultivated fish species for human consumption worldwide. Zebrafish, a species closely related to carp, offers the advantage of a well-recognized low-cost animal model which allows to study the role of different genes, using genetically modified fish lines.

We are convinced that a more detailed recognition and knowledge of immune-stress interactions will allow to develop and to improve strategies for fish health control. It will facilitate the design of new techniques to efficiently and accurately determine the status of animals that are combatting a stressful living environment. It will moreover provide essential knowledge to improve the aquaculture practice and prevent negative effects of stress in fish and, in the future, in human beings.