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Transcription of T cell-related genes in teleost fish, and the European sea bass (*Dicentrarchus labrax*) as a model

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ABSTRACT

In recent years the cloning of genes coding for immuno-regulatory peptides, as well as the sequencing of genomes, provided fish immunologists with a growing amount of information on nucleotide sequences. Research is now also addressed in investigating the functional immunology counterpart of nucleotide sequence transcripts in various fish species. In this respect, studies on functional immunology of T cell activities are still at their beginning, and much work is needed to investigate T cell responses in teleost fish species.

In this review we summarise the current knowledge on the group of genes coding for main T cell-related peptides in fish, and the expression levels of these genes in organs and tissues. Particular attention is paid to European sea bass (*Dicentrarchus labrax*), a marine species in which some information on functional immunology has been obtained, and we reassume here the expression of some T cell-related genes in basal conditions. In addition, we provide original data showing that T cells purified from the intestinal mucosa of sea bass with a specific mAb, express transcripts for TRβ, TRγ, CD8α, and RAG-1, thus showing similarities with intra-epithelial leucocytes of mammals.

1. Introduction

Teleost fish is the oldest Vertebrates displaying all main features of the immune system as they are known in mammals, with the lacking of bone marrow and lymph nodes. Acquired immune responses are well represented in teleost fish, and all main molecular components of adaptive responses, like those regulating in Vertebrates the capability of being vaccinated and maintain an immune memory, have been identified. These components include major histocompatibility complex (MHC), recombination-activating genes (RAG), T cell receptors (TR), B cell receptors (BCR), and B and T lymphocytes.

Despite almost 70 years of knowledge on B cell activities in fish [1], T cells and their activities have been more elusive to be investigated for a cronical lack of specific monoclonal antibody markers for T cells of teleosts.

The existence of T cell populations has been known within bony fish since the 1970s [2], as demonstrated *in vitro* by the proliferation induced with mitogens [3–5], by the responses in the mixed-leukocyte reaction [6], and by the function as helper cells in antibody production against thymus-dependent antigens [7]. The sea bass is, at present, the only marine species for which a specific anti-T cell marker is available, namely the mAb DLT15, specific for thymocytes and peripheral T cells [8]. This antibody is able to recognize both live cells and tissue sections, and its use in indirect immunofluorescence (IIF) and cytofluorimetric analysis of leucocyte fractions permitted the first evaluation of a T cell population in a fish species (sea bass), consisting of 3% of PBL, 9% of splenocytes, 4% of head-kidney cells, 75% of thymocytes, 51% of GALT, and 60% of gill-associated lymphoid tissue [9]. In a demand for oral delivery of antigens in fish, the gut-associated lymphoid tissue has been the subject of particular research, since it revealed a striking abundance of T cells [10], and a remarkable precocity of their appearance during development [11].

The mAb DLT15 was used in immunocytochemistry to show in fish the first T cell activity *in vivo,* in which muscle transplants grafted onto allogenic recipient fish showed that many cells infiltrating the tissue were DLT15-positive [12]. The antibody was also employed to purify T cells from blood and gut-associated lymphoid tissue [13], and the recovery of DLT15-purified cells was >90% for gut-associated lymphoid tissue, and >80% for blood leucocytes.

Subsequently, it was reported the first direct quantitative determination of an *in vitro* T cell activity by measuring an increase

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