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Early Transcriptome Responses to Piscine orthoreovirus-1 in Atlantic salmon Erythrocytes Compared to Salmonid Kidney Cell Lines

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Abstract : Fish red blood cells (RBC) are nucleated, and in addition to their function in gas exchange, they have been characterized as mediators of immune responses. Salmonid RBC are the major target cells of Piscineorthoreovirus (PRV), a virus associated with heart and skeletal muscle inflammation (HSMI) in farmed Atlantic salmon. The activation of antiviral response genesin RBChas previously been described in ex vivo and in vivo PRV-infection models, but not explored in the initial virus encounter phase. In the present study, mRNA transcriptome responses were explored in erythrocytes from individual fish, kept ex vivo, and exposed to purified PRV for 24 hours. The responses were compared to responses in macrophage-like salmon head kidney (SHK-1) and endothelial-like Atlantic salmon kidney (ASK) cells, none of which support PRV replication. The comparative analysis showed that the antiviral response to PRV was strongest in the SHK-1 cells, with a set of 80 significantly induced genes (≥ 2-fold upregulation). In RBC, 46 genes were significantly upregulated, while ASK cells were not significantly responsive. In particular, the transcriptome analysis of RBC revealed that PRV significantly induced interferon regulatory factor 1 (IRF1) and interferon-induced protein with tetratricopeptide repeats 5-like (IFIT9). However, several interferon-regulated antiviral genes which have previously been reported upregulated in PRV infected RBC in vivo (myxovirus resistance (Mx), interferon-stimulated gene 15 (ISG15), toll-like receptor 3 (TLR3)), were not significantly induced after 24h of virus stimulation. In contrast to RBC, these antiviral response genes were significantly upregulated in SHK-1. These results confirm that RBC are involved in the innate immune response to viruses, but with a delayed antiviral response compared to SHK-1. A notable difference is that interferon regulatory factor 1 (IRF-1) is the most strongly induced gene in RBC, but not among the significantly induced genes in SHK-1. Putative differences in the binding, recognition, and response to PRV, and any link to effects on the ability of PRV to replicate remains to be explored.

Keywords : antiviral responses, atlantic salmon, piscine orthoreovirus-1, red blood cells, RNA-seq
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