and vaccine model. The further use of the MVs as vaccines in their natural hosts such as strain-specificity and cross-immunity will be discussed.

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**O-010.**

**Potential role of rainbow trout red blood cells as mediators in the immune response induced by DNA vaccines**

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Abstract
Fish red blood cells (RBCs), unlike mammals, possess nucleus and organelles in their cytoplasm that give them the necessary machinery to generate an immune response at transcriptional and at proteomic level. In the last years nucleated RBCs have demonstrated to act as phagocytic cells, release cytokine-like factors and modulate leukocyte activity upon different stimulus. Also, they have been implicated in the response against viral infections. And recently, rainbow trout RBCs have been also implicated in the immune response to a DNA vaccine. So far, DNA vaccination is the best strategy to prevent and control viral infections, and for fish rhabdoviruses, only the DNA vaccine based on glycoprotein G (gpG) have resulted effective. However, the whole mechanisms involved in this protection and the immune response triggered by the DNA vaccine remain to be fully understood. In order to investigate the role of nucleated RBCs in DNA vaccination, we evaluated the immune response triggered by a DNA vaccine encoding the gpG of viral hemorrhagic septicaemia virus (VHSV) (GVHSV) in rainbow trout RBCs and explored RBCs as future targets or carriers for DNA vaccination. Upon fish vaccination of rainbow trout with GVHSV DNA vaccine, RBCs upregulated antigen presentation pathways at transcriptome and proteome level. In addition, rainbow trout RBCs responded to the DNA vaccine upregulating interferon type 1 (IFN-1) pathway. Also, RBCs transfected *in vitro* with GVHSV DNA vaccine protected RTG-2 cell line against subsequent viral infection. Besides, RBCs carrying the GVHSV DNA vaccine were able to induce specific antibody against VHSV *in vivo*. Also, RBCs transfected *in vitro* with GVHSV were able to modulate leukocyte activity *in vitro*. In summary, we suggest nucleated RBCs as cell mediators of the immune response playing an active role in DNA vaccination and propose nucleated RBCs as potential cell targets or carriers of antiviral prophylactics.
**Keywords:** Red blood cells, DNA vaccine, GVHSV, transcriptome, proteome

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**O-011.**

**Characterization of immune responses in different environmental temperature through linear array epitope vaccine induction**

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Abstract
Grouper fish have a very high value economically and also nutritionally; these make them a very important fish species across the world. However, this fish often suffers a very high mortality rate, up to 90%-100% whenever they are infected with a virus and always bring about a tremendous lost to the farmers of the relative fisheries. As fishes are ectothermic animals, where their bodily temperature and the immune system are regulated by the constant change of environmental temperature, we would like to characterize the vaccine in immune response induction upon virus infection in fish under various modulation of temperatures. Previously, our previous study has developed a vaccine NNVCP-S5E that was developed by a PCR based technique, linear array epitope (LAE) where the immunogen is having multiple linear epitope copies, which were predicted and chosen from NNV and the epitopes are amplified by template-repeat polymerase chain reaction (TR-PCR). Efficacy tests of the vaccine have been done on NNV challenged fishes previously and the relative percent survival (RPS) results were 72%, which indicates that NNVCP-S5E provides an effective prevention against NNV infection. However, the immune response characterized, whether TH1 or TH2 immune pathway is induced by vaccination of LAE vaccine in different temperatures are still unknown. Thus, juvenile giant grouper (*Epinephelus lanceolatus*) is used as a test subject in this project and the fishes were first acclimatized under three temperatures, 20°C, 28°C and 36°C for 1 week, and vaccinated through intraperitoneal injection (IP). Then, the fishes are challenged with purified NNV with a median lethal dosage, LD50 of 3.16.105copies/mL, and sacrificed to obtain immune related organs such. Real-time PCR (RT-PCR) is done in order to investigate the mRNA expressions of the TH1 or TH2 immune pathway markers, *T-bet* for TH1 pathway; *Gata-3* and *c-Maf* for TH2 pathway. Based on the RT-PCR analysis from all three groups, the gene expression results indicate that the vaccination tends to direct the fish immune response towards TH2 pathway of the adaptive immune response, which is a pathway towards the proliferation of B cells and a stronger antibody production. Furthermore, the study also shows a higher survival rate for the fishes that were acclimatized and vaccinated under 35°C compared to other temperatures after challenged with NNV for 14 days. This study contributed different insights which would help in a better protection against virus infection.
**Keywords:** Linear Array Epitope Vaccine, Grouper, Nervous Necrosis Virus, Temperature Difference, Immune Pathway

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**O-012.**

**Stress hormones modulate early immune activities inthe head kidney of *Coregonus maraena***

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Abstract
Under challenging conditions including threat and discomfort, the vertebrate stress response triggers endocrine and neurologic networks. They release stress hormones such as cortisol and catecholamines in the head kidney. This endocrine and hematopoietic tissue is thus of central