

# Marcadores inmunológicos y su uso como rasgos de resistencia frente al piojo de mar *Caligus rogercresseyi*

D. Torrealba<sup>1\*</sup>, L. Mercado<sup>2</sup> y J. Gallardo-Matus<sup>3</sup>

<sup>1</sup> Instituto de Ciencias de la Ingeniería, Universidad de O'Higgins, Rancagua, Chile

<sup>2</sup> Grupo de marcadores Inmunológicos, Laboratorio de Genética e Inmunología Molecular, Instituto de Biología, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile

<sup>3</sup> Laboratorio de Genética y Genómica Aplicada, Escuela de Ciencias del Mar, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile

\*debora.torrealba@uoh.cl; jose.gallardo@pucv.cl

- Alejo, A. & Tafalla, C. 2011. Chemokines in teleost fish species. *Dev. Comp. Immunol.*, 35: 1215-1222.
- Aykanat, T., Heath, J.W., Dixon, B. & Heath, D. 2012. Additive, non-additive and maternal effects of cytokine transcription in response to immunostimulation with *Vibrio* vaccine in Chinook salmon (*Oncorhynchus tshawytscha*). *Immunogenetics*, 64: 691-703.
- Boxshall, G. 2000. On the identity of the common Caligus (Copepoda: Siphonostomatoida: Caligidae) from salmonid netpen system in southern Chile. *Contributions to Zoology*, 69: 137-146.
- Bethke, J., Rojas, V., Berendsen, J., Cardenas, C., Guzman, F., Gallardo, J.A. & Mercado, L. 2012. Development of a new antibody for detecting natural killer enhancing factor (NKEF)-like protein in infected salmonids. *J. Fish Dis.*, 35: 379-388.
- Bassini, L., Lhorente, J., Oyarzún, M., Bangera, R., Yañez, J. & Neira, R. 2019. Genetic parameters for *Piscirickettsia salmonis* resistance, sea lice (*Caligus rogercresseyi*) susceptibility and harvest weight in rainbow trout (*Oncorhynchus mykiss*). *Aquaculture*, 510: 276-282.
- Correa, K., Lhorente, J., Bassini, L., López, M., Di Genova, A., Maass, A., Davidson & W., Yañez, J. 2017. Genome wide association study for resistance to *Caligus rogercresseyi* in Atlantic salmon (*Salmo salar L.*) using a 50K SNP genotyping array. *Aquaculture*, 472: 61-65.
- Dresdner, J., Chávez, C., Quiroga, M., Jiménez, D., Artacho, P. & Tello, A. 2019. Impact of *Caligus* treatments on unit costs of heterogeneous salmon farms in Chile. *Aquac. Econ. Manag.*, 23: 1-27.
- Holm, H.J., Skugor, S., Bjelland, A.K., Radunovic, S., Wadsworth, S., Koppang, E.O. & Evensen, O. 2017. Contrasting expression of immune genes in scaled and scaleless skin of Atlantic salmon infected with young stages of *Lepeophtheirus salmonis*. *Dev. Comp. Immunol.*, 67: 153-165.
- Figueroa, C., Bustos, P., Torrealba, D., Dixon, B., Soto, C., Conejeros, P. & Gallardo, J.A. 2017. Coinfection takes its toll: Sea lice override the protective effects of vaccination against a bacterial pathogen in Atlantic salmon. *Sci. Rep.*, 7: 17817.
- Goncalves, A.T., Collipal-Matamal, R., Valenzuela-Muñoz, V., Nunez-Acuna, G., Valenzuela-Miranda, D. & Gallardo-Escarate, C. 2020. Nanopore sequencing of microbial communities reveals the potential role of sea lice as a reservoir for fish pathogens. *Sci. Rep.*, 10: 2895.
- González, L. & Carvajal, J. 2003. Life cycle of *Caligus rogercresseyi*, (Copepoda: Caligidae) parasite of Chilean reared salmonids. *Aquaculture*, 220: 101-117.
- González, L., Vargas-Chacoff, L. & Marin, S.L. 2016a. Stress response of *Salmo salar* (*Linnaeus 1758*) when heavily infested by *Caligus rogercresseyi* (Boxshall & Bravo 2000) copepodids. *Fish physiology and biochemistry*, 42: 263-274.
- González, M.P., Muñoz, J.L.P., Valerio, V. & Vargas-Chacoff, L. 2016b. Effects of the ectoparasite *Caligus rogercresseyi* on *Salmo salar* blood parameters under farm conditions. *Aquaculture*, 457: 29-34.
- Lhorente, J.P., Gallardo, J.A., Villanueva, B., Araya, A.M., Torrealba, D.A., Toledo, X.E. & Neira, R. 2012. Quantitative genetic basis for resistance to *Caligus rogercresseyi* sea lice in a breeding population of Atlantic salmon (*Salmo salar*). *Aquaculture*, 324-325: 55-59.
- Lhorente, J.P., Gallardo, J.A., Villanueva, B., Carabano, M.J. & Neira, R. 2014. Disease resistance in Atlantic salmon (*Salmo salar*): Coinfection of the intracellular bacterial pathogen *Piscirickettsia salmonis* and the sea louse *Caligus rogercresseyi*. *PLoS ONE*, 9: e95397.
- Morales-Lange, B., Bethke, J., Schmitt, P. & Mercado, L. 2015. Phenotypical parameters as a tool to evaluate the immunostimulatory effects of laminarin in *Oncorhynchus mykiss*. *Aquac. Res.*, 46, 2707-2715.
- Rhee, S. 2016. Overview on Peroxiredoxin. *Mol Cells*, 39: 1-5.
- Robledo, D., Gutierrez, A., Barria, A., Lhorente, A., Houston, R. & Yañez, J. 2019. Discovery and Functional Annotation of Quantitative Trait Loci Affecting Resistance to Sea Lice in Atlantic Salmon. *Frontiers in Genetics*, 10: 56- 66.
- Roed, K., Fevolden, S. & Fjalestad, K. 2002. Disease resistance and immune characteristics in rainbow trout (*Oncorhynchus mykiss*) selected for lysozyme activity. *Aquaculture*, 209: 91-101.
- Rojas, V., Morales-Lange, B., Guzmán, F., Gallardo, J.A. & Mercado, L. 2012. Immunological strategy for detecting the pro-inflammatory cytokine TNF-alpha in salmonids. *Electron. J. Biotechnol.*, 15: 21.
- Srisapoome, P., Chatchaiphan, S., Bunnoy, A., Koonawootrittriron, S. & Na-Nakorn, U. 2019. Heritability of immunity traits and disease resistance of bighead catfish, *Clarias macrocephalus* Gunther, 1864. *Fish Shellfish Immunol.*, 92: 209-215.
- Tsai H.Y., Hamilton A., Tinch A.E., Guy D.R., Bron J.E., Taggart J.B., Gharbi K., Stear M., Matika O., Pong-Wong R., Bishop S.C. & Houston R.D. 2016. Genomic prediction of host resistance to sea lice in farmed Atlantic salmon populations. *Genet Sel Evol*, 48: 47.