



Molecular portrait of egg quality and novel maternal-effect genes

Caroline Cheung, Thuy Thao Vi Nguyen, Aurélie Le Cam, Amélie Patinote, D. Zarski, Laurent Journot, Christelle Reynes, Julien Bobe

► To cite this version:

Caroline Cheung, Thuy Thao Vi Nguyen, Aurélie Le Cam, Amélie Patinote, D. Zarski, et al.. Molecular portrait of egg quality and novel maternal-effect genes. 11. International Symposium on Reproductive Physiology of Fish, Instituto Nacional de Pesquisas da Amazônia (INPA). Manaus, BRA, Jun 2018, Manaus, Brazil. 251 p. hal-01809604

HAL Id: hal-01809604

<https://hal.science/hal-01809604>

Submitted on 2 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

LECTURE 6

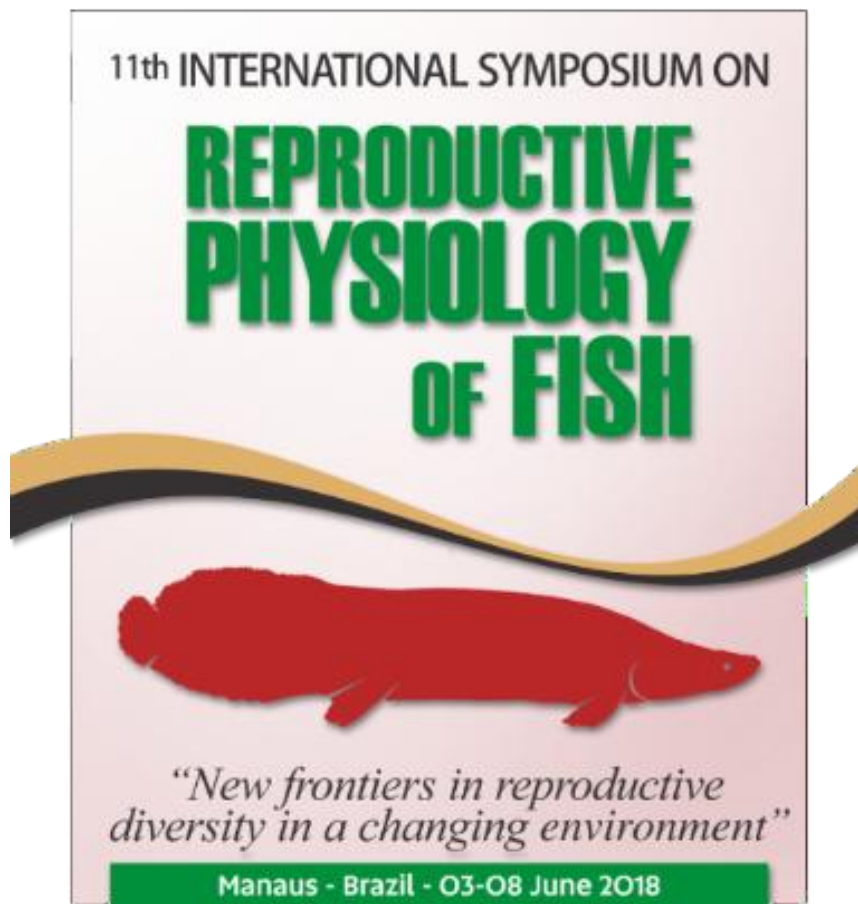
MOLECULAR PORTRAIT OF EGG QUALITY AND NOVEL MATERNAL-EFFECT GENES

Cheung CT. (1), Nguyen T. (1), Le Cam A. (1), Patinote A. (1), Zarski D. (2), Journot L. (3, 4), Reynes C. (4), Bobe J. (1)

(1) Fish Physiology and Genomics Institute (INRA), 35000 Rennes, France, (2) University of Warmia and Mazury, Olsztyn, Poland, (3) Montpellier GenomiX, 34000 Montpellier, France, (4) Institut de Génomique Fonctionnelle, 34000 Montpellier, France. e-mail: julien.bobe@rennes.inra.fr

Good quality or developmentally competent fish eggs are successfully fertilized and develop normally as viable, non-malformed embryos. However, the detailed mechanisms involved in egg quality remain poorly understood and, at present, no predictive markers of egg quality exist. Early developmental success relies on maternally-inherited molecules deposited in the oocyte throughout oogenesis, and over the last few years, our work has aimed at drawing the molecular picture of poorly competent (i.e. bad quality) fish eggs in order to (1) further uncover the molecular mechanisms associated with low developmental success, (2) reveal new maternal-effect genes that play important roles during early development, and (3) possibly obtain molecular signatures based on maternal mRNA profiles in fertilized eggs that could be used as predictive markers of good quality eggs. A large transcriptomic analysis was performed in zebrafish (*Danio rerio*) using a high number of egg clutches obtained under normal husbandry conditions that reflect naturally occurring variability in egg quality. The differentially expressed gene profile revealed dysregulation of genes involved in translation and protein synthesis. Interestingly, translation was also one of the main processes dysregulated in a similar study conducted in Sea Bass (*Dicentrarchus labrax*). Analysis of a smaller number of zebrafish females that consistently produced bad eggs demonstrated a much lower variability in expression profiles that resulted in a higher number of differentially expressed genes identified between good and bad quality eggs. These indicate that while common/general traits of bad quality egg exist, a multiplicity of other factors can dysregulate specific processes that ultimately lead to reduced egg quality. To gain insight into their functions, genome editing using the CRISPR/Cas9 technology was performed to create mutants of two new potential maternal-effect genes, otulina (OTU deubiquitinase with linear linkage specificity a) and slc29a1a (solute carrier family 29, member 1a), that are especially abundant in the ovary. Due to the high efficiency of this technique, mutations could not be transmitted to the next generation and the phenotype was analyzed in F0 females. We observed that both otulina and slc29a1a mutant-derived eggs had very low developmental success. Eggs from mutant females crossed with vasa:eGFP males do not contain GFP, suggesting that they cannot be fertilized. These novel findings showed for the first time that otulina and slc29a1a are essential for the developmental competence of eggs, therefore, are crucial maternal-effect genes. Finally, we applied statistical modeling using Partial Least Square (PLS) regression and genetic algorithm to our data to search for possible molecular signatures. We observed the presence of strong gene signatures, which were statistically robust both in terms of reproducibility and validation by pseudo-data, to link gene expression to the survival rate of eggs in our transcriptomic data. In summary, the molecular mechanisms that control egg quality are complex and probably variable even though some core processes including translation and proteins synthesis appear to play a key role. Yet, some maternal-effect genes have been identified that are important for fertilization. Finally, it appears possible to statistically predict developmental success based on the molecular portrait of the egg.

PROGRAM AND ABSTRACTS



**11 ISRF
2018**