GENETIC IMPROVEMENT OF AQUACULTURE SPECIES IN THE GENE EDITING ERA

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Genetic improvement of aquaculture species through well-managed breeding programmes is a cornerstone of sustainable production. Gene editing presents exciting new opportunities to achieve this, with potential to achieve rapid improvement in production traits in a short timeframe. However, it is also a disruptive technology which requires significant changes to existing operations in order to develop commercially-viable gene edited lines. Existing gene editing methods for aquaculture species typically involve microinjection of CRISPR molecules in early embryonic development, which is laborious and results in highly mosaic animals. Therefore, there are major technical issues to address to improve the efficiency and scalability of gene editing for commercial application. Avenues to explore to address this include mass delivery of gene editing molecules, for example, via sperm-mediated transfer or egg electroporation, or editing and transfer of germ cells to sterilised surrogate broodstock for gamete production. Gene editing technology will require a phased introduction into commercial operations, and therefore introducing edits into commercial product lines rather than into the core breeding nucleus is prudent. This approach also facilitates the concurrent introduction of sterility into edited lines, potentially a pre-requisite for commercial products. The implications of gene editing for routine breeding programme operations include changes in genetic architecture, and potential epistasis, for target traits in edited commercial lines. Finally, gene editing has side benefits relating to the ability to increase selection intensity on other traits, and reduced need for annual disease challenge experiments. This paper discusses the challenges and opportunities of integration of gene editing technology into a commercial aquaculture breeding programme.