BENCHMARK GENE EDITING POSITION STATEMENT

Background

Benchmark is a leading aquaculture biotechnology company, providing products and solutions in Genetics, Advanced Nutrition and Health to help aquaculture producers improve their yield, quality and animal welfare. Innovation is a core value of Benchmark, and we are continuously evaluating the potential of emerging trends and technologies to develop or improve our products. In so doing, we promote a sustainable future for aquaculture and its role in global food security. Benchmark Innovation Board is our forum for fostering collaborative R&D across Genetics, Nutrition, and Health, and recently identified gene editing as the most pertinent disruptive technology for the company. This is due to the technologies potential to offer breakthrough solutions for improved animal welfare, reduced environmental impact, and improved competitive position.

Gene editing is a method to achieve specific and targeted changes to the genome of a species of interest. The most common method of achieving gene editing is using the CRISPR/Cas9 system, which a double-strand break (DSB) at a user-defined locus, enabling imperfect or targeted repair to create alterations to the sequence of the genomic DNA. Technical developments and innovations in recent years have enabled improved precision of editing, with very low off-target rates, and broadening of the range of target sites accessible via alternative Cas9 proteins. Furthermore, extensions of the CRISPR/Cas9 editing system now allow researchers to achieve gene activation or inhibition or swapping nucleotide bases without introducing DSBs.

Gene editing has significant potential for applications to improve welfare and production traits in aquaculture, with responsible and informed use of the technology likely to benefit aquaculture sustainability in the next decade. The most directly relevant applications are likely to be genetic improvement of target production and health traits in aquaculture species. The technique of CRISPR gene editing has been successfully trialled in many aquaculture species, and research using gene editing to identify genes of scientific and commercial importance in aquaculture is becoming commonplace, with some early-stage commercial applications (e.g. pufferfish and red sea bream in Japan).

Gene editing typically results in minor changes to the genome of target species, and these changes may have occurred (or may occur in the future) naturally via spontaneous mutation. The technology is therefore clearly distinct from genetically modification, in which genetic material is typically transferred across species using transgenesis resulting in a Genetically Modified Organisms (GMO). GMOs became the subject of moral and regulatory debate with regulatory acceptance of particular GMO crops in some regions, but very limited acceptance of GMO's in animal production. Transgenesis in microorganisms has been widely applied and resulted in novel products used extensively in food, drug and other manufacturing processes.

Benchmark gene editing position

- Benchmark believes that gene editing technology holds significant potential to improve sustainable aquaculture production, reduce environmental impact, and to improve animal health.

- Benchmark considers that gene editing can be a tool to advance genetic improvement of aquaculture species, as an integrated component of a well-managed selective breeding programme. In addition, we see potential of gene editing tools in microorganisms and cell lines to support new biotechnological innovations, and the potential of gene editing of parasites to develop new biological control measures.

- Benchmark recognises that gene editing is one of many potential tools for improving health and welfare of farmed animals along with conventional breeding, nutrition, vaccination, health management, and husbandry.

- Benchmark considers that gene editing technology should be evaluated by regulators and the industry in a constructive manner considering the clear opportunities it presents, relative to any potential risks.

- Benchmark's applications of gene editing technologies will be entirely consistent with our core mission, and our responsibility to act as guardians of the animals under our care, developing strains capable of high performance in modern production systems, under management systems which deliver high standards of health and welfare, with nutrition which meets the requirements of all stages of the reproduction and production process.

Benchmark gene editing actions

Benchmark will take the following actions towards evaluating and enabling gene editing technologies to benefit aquaculture research, production and sustainability via the following routes:

- Benchmark will instigate internal research and development to develop methods for precise and scalable gene editing of aquaculture species, to enable commercial development and production of gene edited products of substantial benefit to farmers, animals, and the environment, when the regulatory and commercial environment is conducive.

- Benchmark will continue to take leading roles in research consortia including collaboration with leading research institutions and companies to identify specific genes and target edits with potential beneficial effects on production and health traits (e.g. disease resistance).

- Benchmark will take active roles with appropriate government, regulatory, societal, media, and regulatory stakeholders to communicate in an open manner about our R&D using gene editing, how the technology differs from current approaches, and to debate the potential benefits and risks of the technology.

- Benchmark will harness synergy between genetics, health, and nutrition innovations to provide more holistic solutions to sustainability and health challenges in aquaculture, of which gene editing may be a component.

- Benchmark will carefully consider potential commercial applications of gene editing on a case-by-case basis. This will take into consideration the potential ethical, economic and environmental impacts associated with the application of gene editing for the animal itself, the production system, the producer, potential consequences on aquacultural practices, food systems and downstream effects on the environment.

- Benchmark will seek to thoroughly and proactively seek solutions to minimise any potential risks of gene editing technology. This will include extensive evaluation of the health, welfare, and performance of animals carrying a favourable edit, and developing viable solutions for commercial-scale sterility.