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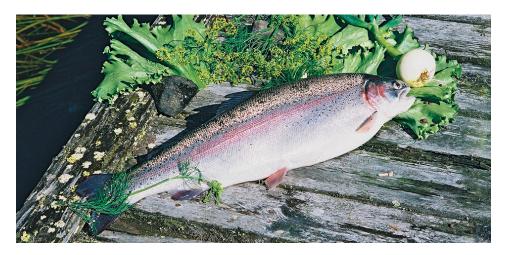**Responsible Seafood ADVOCATE**

Health & Welfare

Improved salmonid quality through selective breeding

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Studies in Finland find four key quality traits displayed significant genetic variation

Rainbow trout exhibit genetic correlations between growth rate and quality traits.

A highly valued feature of salmonid fish is their reddish meat color, which results from carotenoid pigments in their feed. Carotenoids are one of the most expensive fish feed ingredients. Fish-farming production efficiency and profitability can be increased by improving the ability of fish to incorporate carotenoids from feed into their flesh.

Body composition and meat quality are further essential characteristics of farmed fish, because they influence consumer acceptance and affect processing. The production of high-quality fish also involves improving production efficiency, because aquafarmers want to produce as much high-quality edible meat as possible for a given amount of aquafeed used.

Improving quality

Among farm animal producers, much attention has been paid to body and meat composition, mainly due to the reduction in meat quality that results during breeding programs, but also increased awareness by meat processors and consumers. These same issues can be addressed to improve quality in fish farming, but information is limited on the genetic properties of quality traits for aquaculture species.

Key traits

To examine the potential for the genetic improvement of rainbow trout (*Oncorhynchus mykiss)*, the authors recently carried out a quantitative genetic study within a large-scale breeding program maintained by the Finnish Game and Fisheries Research Institute (FGFRI) and MTT Agrifood Research Finland.

The analysis of 3-year-old, 3-kg fish revealed that four key quality traits – fillet redness, fat content, amount of visceral fat, and percentage of body weight – displayed significant genetic variation. This allows their effective genetic improvement along with the highly heritable, main production traits of growth rate and timing of maturity.

These results were encouraging for practical applications. Using selective breeding, rainbow trout flesh can be made redder and its fat content reduced. Selection for the amount of visceral fat and percent fillet weight can, in turn, be applied to increase the amount of fillet produced per fish. These practices increase fish quality and make fish production more cost effective.

Because fat is a fundamental component in physiological processes such as reproduction, fish need operative intestines to effectively convert feed to fish biomass. Care should be taken to monitor the impact of quality selection on reproduction, survival, and feed efficiency.

Analysis also showed that mature fish displayed reduced meat quality. To control for the maturity-induced quality reduction, the timing of maturity was included in the selection index of the FGFRI /MTT breeding program.

Growth rate and quality traits

Genetic correlations between growth rate and quality traits can predict the degree to which the qualities change when selection is applied to growth rate. Analyses showed that no strong correlated responses are expected in fillet redness and percent fillet fat when fish are selected for rapid growth rate. But a

positive genetic correlation between visceral fat and body size indicated that fast growth may be genetically associated with increased amounts of fat storage. Similar results have been observed in other meat industry species like chicken.

When producers select for rapid growth but not against the amount of fat storage, the latter can increase during a breeding program. Such unfavorable correlated changes should especially motivate producers to consider the quality traits in their fish-breeding programs. In addition to selective breeding, the quality traits discussed in this article can also be improved using specific diet formulations.

European union project

Novel methods for quality improvement are being further developed in the European Union-funded project PROGRESS – Protein and Growth Efficiency in Salmonid Selection – established by FGFRI, MTT, the United Kingdom's University of Aberdeen, and the Institute of Marine Research in Norway.

An integration of quantitative genetics, animal physiology, and animal nutrition is being used to find tools for the selective breeding of feed efficiency and meat quality in rainbow trout. The project is expected to have a significant impact on the fish-farming industry by providing tools to enhance end-product quality, and reduce feed costs and environmental impacts.

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