# FEEDING AN EXERCISING FISH

**T. Sigholt**

*BioMar AS, Trondheim, Norway*

Feeding an exercising fish in commercial fish farming implies two main challenges: 1) to provide diets that optimize growth, health, well-being and quality of the final product in a cost-optimal way and 2) to deliver the pellets to the fish with a minimum of feed waste and discharge of carbon, nitrogen and phosphorous to the environment.

Increasing evidence suggest that exercise in teleost fish may result in higher growth rates, better bone quality, higher skeletal muscle mass, reduced aggressive interactions, increased survival and increased immune status and disease resistance.

Raising fish with a swimming speed lower than the optimal may lead to a loss of energy due to higher spontaneous activity (e.g., aggression), while swimming speeds higher than optimal may cause anaerobic metabolism, increased lactate level in muscle and stress that have a negative influence on immunocompetence. Thus, providing an optimal water current for the different size classes during a production cycle is important to exploit the positive effects on of exercise in fish farming.

During exercise skeletal muscle undergoes morphological and biochemical changes and genes involved in muscle growth are upregulated. Exercise further enhances cardiac muscle growth, increases cardiac output and haematocrit levels as an adaption to increased oxygen demand. A diet with the required indispensable amino acid are needed to support this growth, but this may vary according to genetics, environment, growth rate and environmental variables.

Protein will be used not only for growth, but also as supply of energy. In commercial diets, protein is a costly energy source and diets are generally designed to supply a minimum protein level for maximum growth with other nutrients to supply energy (e.g. the protein sparing effect of lipid in salmon diets).

There are conflicting data about partitioning of metabolic fuels in fish as a consequence of exercise. Very different exercise regimes are used and the diets tested may not always meet the energy, protein, amino acid and vitamin requirements. Many species (e. g. salmonids) change their body lipid level during the growth cycle. Exercise may also affect the protein and lipid content in the fish. The protein/lipid ratio in a cost-efficient dietary regime has to reflect these changes. More work need to be done in this area to learn how to make an optimal diet.

Certain dietary components also seem to provide health benefits similar to exercise. E.g. the vitamins C and E may reduce the severity of infections and affect flesh quality. It would be interesting to investigate if an exercise regime and proper nutrition has synergistic or additive effects.  There are also reports showing that exercise causing anaerobic metabolism and accumulation of lactate resulting in production of free radicals that can have a negative health effect. It may be worth investigating if these effects could be mitigated by special diets with boosted levels of vitamins, selected amino acids or other feed components.

Increasing water current in tanks to provide an optimal swimming speed may give a higher mechanical stress on defecated faecal casts, especially during mechanical contact with the wall a in the tank and through drainage piping, causing an increase in number and small faecal particles, which could be a problem for the biofilters in RAS systems. This problem may be solved by improving faeces quality by manipulating dietary raw materials and/or by the use of faecal binders.