

# Horse bean, pea and rape protein and flax seed oil in feed for organic trout

*Alfred Jokumsen, Senior Advisory Scientist, Technical University of Denmark, National Institute of Aquatic Resources (DTU Aqua), The North Sea Research Centre, Hirtshals. Denmark.*

*Organic horse bean, pea and rape may partly replace the fish meal protein, and flax seed oil may replace the fish oil in feed for organic rainbow trout. These are the most recent results from the ORAQUA project.*

*Fish meal and fish oil are unique sources to protein and oil in fish feed due to the optimum content of amino acids and omega-3 fatty acids. However, as these resources are globally very limited, the ORAQUA project is focusing alternative organic plant crops in the feed for organic trout.*

The content of protein in plant crops is lower than that of fish meal (72 %) and therefore only a limited part of the fish meal can be replaced by plant protein. However, the extent of replacement of fish meal is determined by the technologies available for shifting the protein content of the plant crops and in agreement with current organic legislations.

As concerns fish oil the attention is focused to the healthy omega-3 fatty acids, which are very limited in most plant oils. However, flax seed oil is an exception with content of about 60 % omega-3 fatty acids. Therefore, experiments were also performed with replacement of fish oil with flax seed oil.

## **Protein concentrates and experimental diets**

Based on organic horse beans, peas and rape, respectively, experiments have been performed to concentrate their content of protein. According to organic legislations the methods used were exclusively mechanical, i.e. hulling, grinding and air classification. The following contents of raw protein on oil- and water free basis were achieved: Horse bean (59.0 %), peas (57.8 %) and rape (42.6 %).

In 4 experimental diets the inclusion of fish meal gradually were reduced from 59 % (control) to 35 %, by replacing it by a matrix of the 3 protein concentrates by the ratio of 1:1:0,7 to achieve the best possible amino acid profile. In contradiction to conventional feed it is not allowed to balance the amino acid profile by adding artificial amino acids to feed for organic fish.

In 2 additional experimental diets fish oil were half and fully, respectively, replaced by flax seed oil.

## **Growth and digestibility**

Growth and digestibility experiments with rainbow trout were performed at DTU Aqua facilities at the North Sea Research Centre in Hirtshals, Denmark.

No significant differences were found between the diets. All experimental groups showed good growth (about 1.8 %/day) and feed conversion (about 0.75 kg feed/kg weight gain). The digestibilities of protein and fat ranged from 90 – 92 % in all experimental groups, which is very satisfying, and no significant differences were found between any of the nutrient components.

The results showed that the performed replacement of either fish meal by a matrix of horse bean, pea and rape or fish oil by flax seed oil could be done without compromising the nutrient digestibility and growth in rainbow trout.

## **Perspectives**

The unique characteristic of fish as healthy food for humans is their content of the unsaturated omega-3 fatty acids, which primarily are contributed by the fish oil in the fish feed. However,

fish oil is a very limited resource and is currently replaced by competitive plant oils, f. ex. soya oil. Most plant oils are low in omega-3 fatty acids, but they are relatively high in the more saturated fatty acids (omega-6). However, the dietary fatty acid profile is swiftly reflected in the fatty acid profile of the fish and following the use of plant oils in feed for marketable size fish may impact the consumer quality of the fish. Consequently, this quality aspect is considered in the succeeding series of experiments in the ORAQUA project. In addition to flax seed oil attention is paid to grape seed oil due to its high content of omega-3 fatty acids (about 67 %).

The ORAQUA project also includes case studies to compile data on current Danish organic farming systems. Further a feed experiment will be performed at 2 organic farms in 2010. The experimental diets are selected based on the small scale experiments reported above. The two 2 diets are the control diet and the diet, which had the inclusion of fish meal reduced from 59 to 35 % and replaced by the matrix of horse bean, pea and rape.

Informations about the health status of the fish at the organic farms are currently collected in cooperation with the veterinary inspector.

The influence of the experimental diets on the product quality of the organic fish includes objective sensory and biochemical analyses of the meat to evaluate the eating quality.

Thus, the research is primarily focused on the most critical areas in the chain connecting organic feed production, the organic farmers and the consumer.