Camelina Oil in Aquafeeds: Research Supports Key Opportunity

Substantial evidence is now available to show that camelina oil is a viable option to fish oil in diets for salmonids and cod.

Consistently, camelina-containing diets produced fish with equivalent qualities compared to fish that were fed fish oil. Key results include:

- Positive health, growth and immune responses
- Equivalent nutritional yields, particularly in the critical realm of omega 3s
- Optimal marketable traits such as colour and texture

In contrast to other plant-based fish oil replacements, camelina oil’s unique biochemical composition is highly compatible with fish health, performance and product quality.

*With the rigorous tests performed in salmon, rainbow trout and cod, we highly recommend the use of camelina in feed for both salmonids and cod.*

Fish Growth Performance

Feeding trials replaced 100% of fish oil with camelina oil in salmon (smolts), salmon (parr), rainbow trout and cod. Results showed that camelina oil is highly digestible, and growth performance, based on weight gain (>200%) and specific growth rate (>0.9% per day) is acceptable for each species. Statistically, there was no difference in growth performance between fish fed camelina oil and fish oil after a maximum growth period of four months.

Fillet Nutritional Profiles

Extensive lipid and fatty acid analysis suggest that fish that consume a diet with camelina oil produce the same nutritional benefits as fish that eat a diet containing fish oil, in terms of the levels of saturated, monounsaturated and polyunsaturated fatty acids. This makes camelina a superior fat source for fish in comparison to other well-known plant oils such as soy and canola oil.
**Rainbow trout**: Rainbow trout fed 100% camelina oil diets produce fillets with optimal nutritional benefits in terms of lower saturated fatty acids and higher monounsaturated fatty acids and equivalent polyunsaturated fatty acids. One serving (75 g) of rainbow trout fed camelina oil provides 563 mg of healthful DHA+EPA - more than meeting the daily requirement recommended by the WHO. Our trials also show that about 27% of DHA was formed directly from ALA (alpha-linolenic acid) in camelina oil, confirming that trout can use camelina oil to synthesize their own long-chain PUFA.

**Salmon**: One serving (75 g) of salmon raised on a diet containing 100% camelina oil provides 304 mg of DHA+EPA, which again, supplies more than the daily requirement for human consumption. We also conducted a sensory evaluation on raw fillets (based on colour, texture and odor), as well as instrumental analyses of texture and colour. All evaluations showed that salmon that were fed camelina oil were equal to salmon that were fed fish oil, meaning consistent marketability of salmon that are fed camelina oil.

**Cod**: Unlike trout and salmon, cod fillets are naturally low in fat, so even a single serving of wild cod would not provide enough DHA and EPA to meet daily requirements for human consumption. However, our results show that cod were able to make longer chain fatty acids from ALA in camelina oil in comparison with cod fed fish oil. Cod fed either camelina oil or fish oil used fat as an energy source in the same way regardless of diet. This suggests that energy and metabolism of the fish does not change when fed camelina oil.

**Fish Immune Response**

Our tests confirmed that replacement of up to 80% of fish oil with camelina oil does not have a significant impact on the immune system of Atlantic cod. In addition, cod that are fed a diet containing camelina oil can mount a strong anti-viral immune response that is comparable to that of cod that are fed a fish oil diet.

**Camelina’s Unique Chemical Composition**

Camelina’s biochemical composition is unique compared to other terrestrial plant oils. The oil is high in omega-3 (ω3) fatty acids (35%), and contains lower levels of ω6 fatty acids (25%) and ω9 fatty acids (15%), with a ω3/ω6 ratio >1. Both the monounsaturated (MUFA) and polyunsaturated fatty acid (PUFA) content are high compared to the saturated fatty acid content. The fatty acid profile of camelina oil is nutritionally more appropriate for fish diets than other commercially used plant oils, such as canola, soy, corn, peanut and sunflower, particularly due to the high ω3 content. It contains a high amount of gamma-tocopherol, the most potent antioxidant vitamin E isomer; therefore, it is naturally protected against lipid oxidation, despite high levels of PUFAs. It is less susceptible to oxidation than other sources of ω3 fatty acids, such as fish oil and flaxseed oil. Camelina oil is sufficiently stable to constitute a technically and economically competitive alternative to fish oil as a food ingredient source of ω3 PUFA.