

# Fact Sheet

## Developing Alternate Feeds in Finfish Aquaculture



AquaNet's research is focused on finding additional sources of high quality feed ingredients that are economical, safe and nutritious. This research will lead us to a better understanding of how Canada can use Canadian ingredients in fish feeds and can continue to produce top quality fish feed for both domestic and export markets.

AquaNet researchers and sector partners from coast to coast are working in collaborative, multidisciplinary research projects to develop feeds that promote good growth, healthy fish and excellent quality flesh. These current research efforts have been initiated to:

- maintain health promoting omega 3 and omega 6 fatty acid levels;
- ease pressures on finite fisheries that supply fish oil and fish meal in feeds;
- optimise healthy diets for traditional and new aquaculture species;
- develop new value-added products for abundant Canadian prairie crops; and
- continue producing safe and nutritious seafood.

The finite availability of fish meal and fish oil has put pressure on fish feed suppliers to find suitable alternate sources of proteins and oils to be used in fish feeds. The large, readily available oil seed crop from the Canadian prairies is potentially a cost effective and suitable source of both proteins and oils for fish feeds.

"We saw the potential that Canada could not only become self-sufficient for fish meal and fish oil substitutes, but become an exporter to other markets, like Chile;" states Jason Mann, Director of Purchasing and Nutrition at EWOS in North America. "AquaNet has become instrumental in providing research funding to bring these ideas to fruition. This research will benefit both the Canadian aquaculture industry and the Prairie farmers. The return of investment is very large. When you spend a dollar on research and we can make the savings even a small percentage of the feed costs, you have millions of dollars in cost savings."



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Early tests using plant derived proteins and oils from canola, flax and soy beans in the diets of hatchery reared salmonids showed that with the right formula the fish exhibited improved ocean survival. This was the beginning of publicly funded research in Canada into developing and optimising new feed ingredients for finfish aquaculture, complementing research carried out by international feed companies. These initial studies also showed us that we had to increase our knowledge of the interrelationships between nutrition and salmon and trout physiology. The knowledge gaps are even larger for newly cultured marine species, such as Atlantic cod, halibut, and haddock on the east coast and sablefish on the west coast.

AquaNet's research now links academic centres of excellence across the country with the expertise of feed companies, innovative culture operators, grain and oil seed suppliers and government agencies. Researchers have made significant advances in understanding the dietary needs of cultured fish and developing healthy and cost efficient solutions by focusing on:

- nutritional requirements for the different species during the different life stages;
- increasing the digestibility of the diet, which in turn lessens the nutrient flow into the environment;
- maintenance or improvement of fish health;
- eliminating environmental contaminants from the fish's diet while maintaining the beneficial fatty acids for human health; and
- formulating cost effective diets.

In laboratory and field experiments, different diet formulations have been and continue to be tested to partially replace



marine fish oils with vegetable sources such as cold-pressed flaxseed oil, canola oil, and/or poultry oil; and to replace fish meal protein with alternate nutritionally upgraded soybean and canola protein products. The tests are designed to determine the effects of alternative feeds on digestion, immune functions, health, growth, flesh quality and the implications for fish health management.



Fish Species Grouped According to their Flesh Lipid Content		
Group	Lipid Content	Species
Lean Fish	< 1.5%	Cod, Haddock
Low	2-5 %	Tilapia, Catfish, Turbot
Medium	5 - 10%	Halibut, Rainbow trout
High	10 - 20%	Salmon (Atlantic & Pacific species) Sablefish

Summary of preliminary research findings	
Species	Initial Findings
Atlantic Salmon	<p>Extensive (50-75%) replacement of marine fish oil (MFO) with vegetable oils and/or poultry oils.</p> <ul style="list-style-type: none"> <li>• Canola and flaxseed oils alone or blended with poultry oil can be used with no impact on growth performance and immune responses</li> <li>• Incorporating marine fish oils into the finishing diets ensures beneficial highly unsaturated omega 3 and omega 6 fatty acid levels in flesh</li> </ul> <p><b>Issues yet to be investigated</b></p> <ul style="list-style-type: none"> <li>• Lipid digestibility</li> <li>• Impacts on organohalogen levels in flesh</li> </ul> <p><b>Options</b></p> <ul style="list-style-type: none"> <li>• Vegetable oil enrichment with omega 3 fatty acids</li> <li>• Genetically improved fish to enhance lipid conversion</li> </ul>
Chinook Salmon	<p>Up to 50% replacement of marine fish oils with vegetable oils and/or poultry oils</p> <ul style="list-style-type: none"> <li>• Canola oil can be used with no impact on growth and swimming performance</li> </ul> <p><b>Issues yet to be investigated</b></p> <ul style="list-style-type: none"> <li>• Immune responses in fish with replacement oils are to be investigated</li> </ul>

Species	Initial Findings
Sablefish	<p>Up to 75% replacement of marine fish oil can be replaced with cold pressed flaxseed oil and/or poultry oil:</p> <ul style="list-style-type: none"> <li>• No effect on growth rate, health or feed efficiency</li> <li>• Flesh organohalogen contaminant and fatty acid levels under evaluation</li> </ul>
Halibut	<p>Up to 65% of the marine fish oils can be replaced with vegetable oils and/or poultry oil:</p> <ul style="list-style-type: none"> <li>• No effect on growth rate, health or feed efficiency</li> </ul>
Haddock	<p>Up to 65% of the marine fish oils can be replaced with vegetable oils and/or animal fat:</p> <ul style="list-style-type: none"> <li>• Dietary lipid should be 12% for small fish and 15% for larger fish</li> <li>• If within these parameters, no effect on growth rate, health or feed efficiency</li> <li>• The transport of lipid from predominant storage (liver) to muscle is low (= underlying cause of fatty liver syndrome)</li> </ul>
Cod	<ul style="list-style-type: none"> <li>• Enrichment formulation improvements leading to increased survival of first feeding cod larvae</li> <li>• Collaborative research under way with INVE on improving enrichment formulations</li> <li>• Studies on larvae digestive physiology have shown the importance of lipids during start feeding</li> <li>• Impact of diet formulation on flesh quality of larger cod has been completed and results are being analysed</li> </ul>
Trout	<p>Up to 75 % replacement of marine fish oils with vegetable oils without negative effects on growth performance</p> <p><b>Issues yet to be investigated</b></p> <ul style="list-style-type: none"> <li>• Influence vegetable oil substitution on fatty acid profiles</li> <li>• Assessing the ability of novel marine algae to supplement plant oil-replaced diets to ensure highly unsaturated fatty acid (HUFA) profiles in flesh</li> </ul>



Project	Investigators	Collaborators and Partners
Nutritional Strategies to Improve Lipid Utilisation in Diets for Commercially Important Canadian Finfish	<b>Dr. Santosh Lall</b> , Dalhousie University, NRC - Institute of Marine Biosciences <b>Dr. Shannon Balfry</b> , <b>Dr. Brent Skura</b> , University of British Columbia <b>Dr. David Higgs</b> , Department of Fisheries and Oceans <b>Dr. Fereidoon Shahidi</b> , Memorial University of Newfoundland	<b>Mr. Jason Mann</b> , EWOS Canada Ltd. <b>Dr. Bill Kay</b> , Microtek International <b>Dr. Brad Hicks</b> , Taplow Feeds <b>Dr. Chris Frantsi</b> , Heritage Salmon Ltd. <b>Mr. Brian Blanchard</b> , Scotian Halibut Ltd. <b>Dr. David Speare</b> , Atlantic Veterinary College
The effect of alternate dietary lipids on physiological performance measures in Chinook	<b>Dr. Colin Brauner</b> , <b>Dr. Patricia Schulte</b> , <b>Dr. Shannon Balfry</b> , University of British Columbia <b>Dr. David Higgs</b> , Department of Fisheries and Oceans <b>Dr. Robert Devlin</b> , Department of Fisheries and Oceans	<b>Mr. Greg Deacon</b> , Skretting Canada <b>Mr. Jason Mann</b> , EWOS Canada Ltd. <b>Dr. Brad Hicks</b> , Taplow Feeds <b>Mr. David Dyble</b> , Unifeeds <b>Ms. Diane Morrison</b> , Marine Harvest <b>Mr. David Groves</b> , Sea Springs Salmon Farm <b>Mr. Justin Henry</b> , Target Marine Products <b>Dr. Keng Pee Ang</b> , Stolt Sea Farms <b>Ms. Anne Heath</b> , <b>Mr. John Heath</b> , Yellow Island Aquaculture <b>Dr. Bill Kay</b> , Microtek International
Replacement of fish meal and fish oil with canola protein concentrate and dehulled flax in diets fed to rainbow trout ( <i>Oncorhynchus mykiss</i> ).	<b>Dr. Murray Drew</b> , <b>Dr. Andrew Van Kessel</b> , <b>Dr. David Janz</b> , University of Saskatchewan	<b>Dr. David Maenz</b> , MCN Bioproducts Inc.
Vegetable oils as sustainable substitutes to fish oil in Salmonid diets: an approach to minimize contaminants and reduce feed costs	<b>Dr. Grant Vandenberg</b> , <b>Dr. Yvan Chouinard</b> , <b>Dr. Pierre Ayotte</b> , Université Laval <b>Dr. Jean-Philippe Weber</b> , INSPQ <b>Dr. Dominique Bureau</b> , University of Guelph	EWOS Réseau Aquacole de Québec Canola Council of Canada La Société de recherche et de développement en aquaculture continentale inc. (SORDAC) Société de développement de l'industrie maricole inc. (SODIM) Bi-Pro Marketing Ltd.

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