

# **Raw Material Bottlenecks in Aqua Feed Formulation: Fish Meal and Cholesterol as Test Cases**

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## **INTRODUCTION**

In accordance with the expected growth of the aquaculture industry, global aqua feed requirements are projected to grow from 15 MMT in 2000 to 27 MMT by 2010. This will result in an increased demand for - and possibly shortage of - a number of raw materials which are derived from finite natural resources. Severe increases of formulation cost of aqua feeds can only be avoided by increasing the power of least cost formulation, i.e. by offering a wider range of ingredients for which the selection is based on a comprehensive knowledge of nutritional requirements, raw material characteristics and cost. This bottleneck situation in aqua feed formulation is illustrated in this paper with two examples: fish meal/fish oil in feeds for marine fish and cholesterol in feeds for penaeid shrimp.

## **FISH MEAL/FISH OIL: TWO FINITE MARINE RAW MATERIALS**

The production of compound aqua feeds, particularly feeds for carnivorous finfish species and marine shrimp, has so far been dependent upon the use of fish meal (FM) and fish oil (FO) as cost-efficient sources of dietary protein and fat. The world production of these two key ingredients is based on a yearly average catch of 30-36 MMT of low-valued fish species, which are processed into 6.6 MMT of fish meal and 1.25 MMT of fish oil (averages for 1990-2000). Although these average production data are good estimates of the FM/FO supply in most years, the aqua feed industry has to foresee the occurrence of "crisis years" such as 1998 when production fell 25-30% as a result of El Niño. Besides ecological and ethical opposition to the use of finite and valuable aquatic resources as a feed ingredient for high-value species, there is a growing economical concern about the uncertain market availability and cost of FM/FO. Severe increases of formulation cost of aqua feeds can only be avoided by a significant reduction of the inclusion levels of FM/FO.

The drastic replacement of FM/FO by standard sources of plant protein/fat in feeds for marine fish (sea bream/sea bass) reduces feed performance in terms of growth and food conversion, affects liver function and fat deposition in the body, and may change the quality of the final product. Nutritional imbalances and low palatability of low FM/FO

formulations can be compensated by the appropriate supplementation of nutrients and attractants. Specially designed finishing feeds may improve the final product quality of marine fish that have been grown on low FM/FO feeds. These “formulative solutions” could maintain the market pressure on marine resources within acceptable limits during the coming decade.

### **CHOLESTEROL: A FINITE TERRESTRIAL RAW MATERIAL**

Cholesterol is an essential nutrient for penaeid shrimp, which are unable to biosynthesise this compound *de novo*. Fish meal and marine invertebrate meals and oils, such as squid, shrimp, clam, crab, and mussel, are good sources of cholesterol. The addition of typical levels of these marine ingredients usually provides about 60-80% of the cholesterol requirements. As a result, the supplementation of purified cholesterol is needed to fully cover the requirement and this represents a significant -and in practice often prohibitive- cost in shrimp formulations. Cholesterol is purified from wool grease (lanolin), a by-product collected during the washing of sheep wool. The cost and availability of feed-grade cholesterol has shown important fluctuations during the past years due to large variations in supply and demand in the market for wool grease. The need for additional supplementation of cholesterol in shrimp feeds is likely to increase due to the increased pressure on the use of fish meal as protein source for shrimp feeds. The requirements for cholesterol and its replacement are documented with feeding trials.