

Replacing Fish Meal and Fish Oil in Aquaculture with Plant Based Ingredients

Some aquaculture species, such as salmonids and crustaceans, are major consumers of fish meal and fish oil. Such feeds come from industrial fisheries and fish processing. What could be done to compensate if fish meal and fish oil are ever lacking? Increasing the share of plant-based ingredients in fish feed works as a privileged alternative. However, plants do not have the same nutritional properties as fish by-products, so what are the guidelines to follow for finding substitutes?

Several factors must be considered in the event that the share of plants in fish feed is increased. These factors are as below:

The rebalancing of plant ingredients' nutritional inputs in fish meal

Fish meal is undoubtedly a main source of essential amino acids for fish. Fish meal is valuable in its rich content of highly digestible and well-balanced proteins. Choosing plant-based ingredients as an alternative to marine raw materials should ensure that the fish's high requirement of balanced and easily digestible proteins is satisfactorily met. **Meal or protein concentrates from soybeans, canola, peas** etc. can be used for this purpose. A good mixture of plant ingredients can also help balance the supply of essential amino acids.

Raw material	Protein Level (%)
Fish meal	65 - 72
Soybean meal	42 - 47
Peeled and defatted cotton seed meal	40 - 44
Expeller rapeseed meal	31 - 37
Peeled and defatted sunflower seed meal	28 - 32
Corn	7 - 11

Special attention also ought to be paid to **anti-nutritional factors**; some plant raw materials contain these compounds which can prevent the feed from being well digested. These are likely to resist the feed processing and therefore remain in the finished feed.

Elements such as phytoestrogens (found in lupine, soybean or alfalfa for example) can thus disturb the hormonal cycle of certain breeding species. Another example of this kind of element is Gossypol, found in cottonseed cake. Gossypol can decrease the performance as well as the level of ingestion of some species. Another risk worth mentioning that is associated with these factors is the mycotoxin content of plant raw materials.

Fish meal contains a significant amount of minerals that are well digested by various aquatic species. The possibility of readjusting phosphorus, calcium and other minerals levels should therefore be considered as a potential alternative for instance at the formulation stage.

A few equivalents to fish oil

In addition to being highly sought after by consumers, long-chain polyunsaturated fatty acids are essential nutrients for the growth of aquatic animals. For this reason, the fatty acid profile of farmed

fish and shrimp are heavily influenced by the lipid composition of their ingested feed. Some species, including freshwater ones, have the ability to synthesize polyunsaturated fatty acids. Yet marine fish, such as seabass or seabream, are completely devoid of this ability. It is therefore through their feed that these essential fatty acids must be provided.

However, raw materials that can provide such nutrients without being derived from fish processing scarcely exist. Microalgae, insect meal and GM plants are among some possible substitutes. While the two first options have only barely been explored, the use of GMOs has proven relatively successful from a zootechnical point of view. However, this option still has a long way to go before it can gain widespread acceptance.

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