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# Feeding fish without fouling the environment

Aquaculture Department, Southeast Asian Fisheries Development Center

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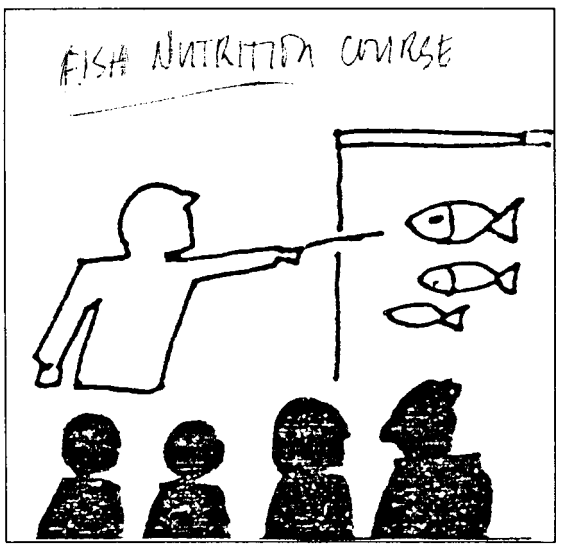
production of farm-made feeds and techniques for on-farm processing and storage should be developed and improved, with funding provided when necessary.

• Feed advisers should formulate feeds taking into account: (1) locally available ingredients; (2) nutritional requirements of farmed species; (3) minimal use of vitamin premixes, binders, and other expensive ingredients; (4) the contribution of natural food in semi-intensive farming systems; and (5) overall quality.

• Feeding strategy should be improved through research and development in: (1) feeding frequency; (2) methods of feed presentation; (3) two-component systems (i.e., alternation of different feeds or feeding rates); (4) reduction of feed wastage; (5) farmer-friendly sensory methods of assessment of ingredient quality; and (6) biomass assessment of farmed species.

• Village-level training can be designed in the local language to teach farmers simple formulation, ingredient choice, feed processing, storage, and on-farm feed management. Instructional videos and simple booklets in the local languages can complement the training course.

Source: Report of SEAFDEC/AQD Scientist RM Coloso regarding his attendance to the FAO Expert Consultative Meeting on Farm-made Aquafeeds; 13-20 December 1992; Bangkok, Thailand.




# Feeding fish without fouling the environment

Fishes excrete ammonia as a waste product of protein breakdown. Ammonia is a toxic pollutant in aquatic systems without plants. The only effective ways to reduce ammonia output are to:

1) balance the protein and energy in the diets;
2) ensure that the protein in the diet is highly digestible; or
3) balance the amino acids.

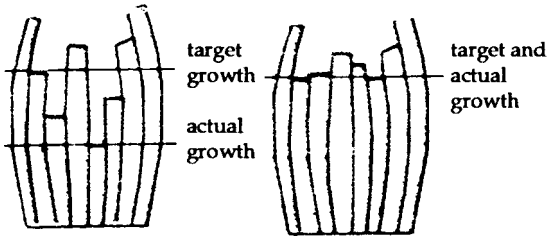
Protein is composed of sequences of 22 different amino acids. Ten of these cannot be made by the fish and have to be provided in the diet; they are termed essential amino acids. Fishes require the same 10 essential amino acids as humans do, but in different proportions.

Fishes use amino acids for protein building only up to the level of the first limiting essential amino acid (see figure next page). The excess amino acids, those out of balance, will be used for energy and excreted. The ammonia output from the fish farm thus increases.

Protein produces lean muscle tissue. It is essential that the amino acids are balanced and supported by the correct level of digestible energy. Fish oil is the preferred energy source for salmon and trout, providing about twice the energy per gram of protein or carbohydrate.

The protein content declaration on a bag of feeds is of limited value because it gives no indication of quality or digestibility. A diet can be formulated with what appears to be a satisfactory protein level, but if the digestibility is poor, and the amino acids are not balanced, then growth will be poor and ammonia output high. Feed manufacturers are beginning to provide more useful information, such as digestible energy, digestible protein, and a list of ingredients (e.g., fish meals, fish oils, soya proteins, cereals, cereal by-products, vitamins, minerals, pigments, antioxidants and stabilizers, binding agents). Such data are still of limited use for determining the nutritional quality of the feed if the sources of ingredients and the processing parameters are not known. Sources of ingredients are kept confidential because companies spend a lot of time and money locating and evaluating

*Amino acid supply and balance*




raw materials from factories around the world and are unwilling to give away information to competitors. The open declaration on feed labels does give assurance that the manufacturers are not using unacceptable raw materials.

The best way to achieve a diet with a well-balanced amino acid profile is to use fish meals from various sources. Fish meals are purchased from many countries and formulated into fish feeds that give the amino acid profile specified by the nutritionist. At least three fish meals are commonly included in commercial rations.

There is very little nutritional value in the vegetable matter suitable for low-pollution feeds for salmon and trout. Vegetable ingredients are usually lower in protein than fish meals and generally have unbalanced amino acid profiles. High levels of plant ingredients tend to increase the biological oxygen demand and the output of suspended solids from the farm. However, low levels provide cost-effective sources of some amino acids and are essential for the physical quality of the product.

In order to produce economical, environmentally friendly, nutrient-dense feeds, manufacturers must use nutrient-dense raw materials. For fishes, this means fish meals with highly digestible protein. However, given the finite quantity of wild fish stocks, it is essential that alternative protein sources are found to replace fish meal as the main protein source.

The most likely replacement for fish meal would be an upgraded vegetable protein. Upgrading would involve concentrating the protein component and removing most of the carbohydrate. This would only become economically feasible when the price of fish meal increases significantly. The vegetable source would also have to be readily available in large quantities.

Development of a suitable raw material and the technology to upgrade it economically is not likely in the short term, and dependence on fish meal will continue for some time yet.

Source: ***Fish Farmer***, January-February 1991.

## Publications and video tapes

**Nutrition and Feeding of *Penaeus monodon*** by FP Pascual. 1989. 24 pp.
Old price: ₱80 US$28
New price: ₱40 US$15

**Feeding Prawns for Grow-out Culture** by FP Pascual and RV Rivera. 1989. 21 pp.
Old price: ₱30 US$28
New price: ₱15 US$14

**Prawn Feed Preparation**. 14 min.
Old price: ₱210 US$20
New price: ₱100 US$15

**Proximate Analysis**. 21 min.
Old price: ₱630 US$60
New price: ₱300 US$30.

Available from the SEAFDEC Aquaculture Department. The Department is also preparing an extension manual on *Feeds and feeding of fishes and tiger shrimp*. This will be available in late 1993.

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