BANGOS NUTRITION STUDIES

by

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Introduction

In the field of animal husbandry, it is generally recognized that sound nutrition is an important determinant for growth, development and reproduction, vital life processes which occur at the expense of energy provided by food. Whether furnished by a ration or availed of from natural sources, quantitative and qualitative requirements for most vitamins, amino acids and whole proteins, fats, carbohydrates, and minerals must be recognized. In addition, a clear distinction must be established regarding the specific role of these various nutrients, for growth and other life processes with respect to age, species characteristics, sex and the modifying effects of environmental factors.

Nutritional studies on domestic animals like the horse, pig, cow and chicken, and including man, have been going on for centuries. Thus, a large amount of background information and technology along this line could be applied with much profit for fish culture today. However, working with fish is relatively more difficult compared with land animals. For instance, being a sensitive poikilothermic animal, painstaking inquiry must be made to identify the nature of specific enzyme systems. In experiments involving land animals, the weight and composition of the food and waste products can be recorded accurately for analytical purposes. On the other hand, since fish live in water, a medium which dissolves the urine and feces, similar accurate data cannot as yet be obtained (Hickling, 1962). It is for the same reason why studies on the bioenergetics of fish have not advanced very far. Furthermore, a fish nutritionist must hurdle unusual problems with regard to the various physical forms of the diet, water stability, frequency of feeding, methods of feed dispensation, stocking rates and other appropriate fishpond management practices.

Nutritional requirements, are now partially known for some species of fish, namely, trout, salmon and channel catfish. Recently, these requirements were incorporated in the latest addition to a series entitled Nutrient Requirements of Domestic Animals published by the Committee on Animal Nutrition, National Research Council of the U.S. National Academy

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of Sciences.

Bangos or Chanos chanos is the principal fin fish raised in about 170,000 hectares of brackishwater fishponds in the country. It appears that the local milkfish industry is, by and large, a unique Filipino creation and that, in spite of the so-called improved techniques advanced by FAO Taiwanese biologists, the Filipino culturists are still very much on their own when it comes to the overall practice of management. However, it will surely be an overstatement to say that there is little that needs to be done with regard to the culture of this fish. For one thing, the biological data on milkfish is far from being complete and perhaps the available ones need further reexamination or confirmation. The rational formulation of supplementary feeds for Chanos, as an innovative form of management, must therefore, be based primarily on a priori knowledge of some of the basic nutritional problems of the fish in the general environmental millieu.

Morphological Considerations

Every species of fish, according to Nikolsky (1965), is adapted to feeding on a particular food source and its sense organs are adapted to seeking out this food, its buccal cavity to seizing it and its intestine to digesting it. On the basis of taxonomic descriptions furnished by Herre and Mendoza (1929) and Bridge and Boulanger (1910), both cited by Schuster (1960), Chanos can be classified, although arbitrarily, as typically herbivorous. In young and mature specimens, the mouth is small, terminal and toothless. The gillrakers are exceedingly fine, numerous and closely set in two diverging rows. The exosphagus, equipped with both spiral and longitudinal folds, terminates at the powerfully developed gizzard, followed by a very long intestine. Pyloric appendages are likewise numerous. Information regarding the mechanism for orientation toward the food source, efficiency and energy requirements of food straining, and characteristics of the digestive enzymes are not available.

Feeding Behaviour

Feeding behaviour is generally species characteristic, a product of evolution. Schuster (1960) made a general statement that Chanos, in all phases of its life, seeks its food during the daytime and that in tropical climates, it feeds with equal vigor at all seasons of the year. Young and adult Chanos in the open littoral waters, were observed feeding on the scum floating at the surface. Moreover, it is a common observation that during certain periods of the year, the larvae and the young fish often move into shallow waters apparently in search for food. It is interesting to note that there is at present no specific fishery for milkfish other than for the fry and until an effective gear is devised for the intermediate and adult-size-groups, the many facets of feeding in the natural habitat will remain a mystery.

In ponds, the larvae, young and adult fish feed on floating materials sucking these in with the current of water (Schuster, 1960). While feeding, the longitudinal axis of the body may be seen at an angle of about 45°. However, there seemed to be no distinct preference for taking food from the upper layers since others can be seen taking food from the bottom (Schuster, 1960), in agreement with the observation of Tang and Hwang (1967).

Chanos given a pelleted ration in earthen ponds were not observed to consume the feed directly off the bottom but fed on fine particles of disintegrated pellets floating on the surface. (IFP Tech. Rep. 1972).

Food Types

Nature offers a great diversity of food to fishes, which includes nutrients in solution and a host of different plants and animals. (Lagler, et al., 1962). The more stable the feeding conditions of the species, the smaller the range of food to which it is adapted; and conversely, the more variable the food supply, the greater the variety of food eaten by the species (Nikolsky 1963). Halver (1970) stated without any clear evidence, that the dissolved cations from the saline environment may satisfy specific requirements for gross and trace mineral considerations in the diet of many fishes.

Analysis of stomach contents of adult Chanos (520-930 mm long) caught from the open littoral waters revealed the presence of predominantly benthic forms, Navicula and Pleurosigma-like diatomaceae, mixed with mineral particles, foraminiferans, gastropods, dead copepods and dead phytoplankters. (Sunier, 1922, cited by Schuster, 1960). It was accordingly appropriate to classify Chanos as a benthic feeder. Chacko (1949), cited by Schuster (1960), presented an opposite view and classified Chanos as a plankton feeder, (the usual organisms found being Hemidiscus, Navicula, Pleurosigma, Thallasiotrix, Coscinodiscus, Fragilaria, Nitschia, Rhizosolenia, Planktionella, Cymbella, Gomphonema, Pinnularia, Biddulphia, Ceratium, Peridinium, Tintinnus, larval bivalves, Diaptomus, Acartia, Evadne, Acetes, Mysis and Lucifer).

In the pond situation, conflicting findings are likewise evident. Rabanal (1951) stated that the natural food of fry and fingerlings under cultivation is the brownish, greenish or yellowish crust of microbenthic fauna and flora which can be readily-grown by specialized pond mangement techniques, particularly fertilization. This is in agreement with the findings of Tang and Hwang (1967), who identified the benthic diatoms, Navicula, Pleurosigma, Mastogloia, etc. together with several species of filamentous blue-green algae as the predominant forms in the algal pasture. Based on both indoor and pond observations, they concluded that these benthic algae furnish the most suitable form of milkfish food and that the milkfish gill-rakers are not well-adapted to filter planktonic algae from the water.

Workers at the Inland Fisheries Project (IFP Tech. Report 1972), however, characterize Chanos as a plankton feeder, based on production records and the overall morphology of the gills. However, the deep water method, has been giving erratic results so that a refinement of the present technique is in order.

Schuster (1960) takes a middle stand and describes Chanos as a facultative feeder. Although unicellular blue-green algae are the principal food elements in one region, he did not exclude the possibility that elsewhere, Chanos would feed mainly on filamentous green algae, depending upon the availability of the food in bulk. However, he added that Chanos prefers soft and easily separable nutritive materials.

Supplementary Feeding

Through scientific use of fertilizers and eradication of pests and predators, yields of close to 2,000 kg/ha have been reached in the mono-culture of milkfish in brackishwater, with either lab-lab or plankton as the food base. However, the average annual production of fishponds in 1973 was only 656 kg/ha, which could mean that the present management program is still very much affected by some uncontrollable events perhaps dictated by regional differences in climate and soil types. Implicit in this statement is the fact that in places where the soil is too poor to raise a decent crop of fish and where the use of fertilizers is impractical and ineffective, supplementary feeding might be considered a necessity.

Even in ponds with moderate to high fertility, higher yields per unit area can only be obtained by stocking more fish and offering them supplemental feeds. This is on account of the unique interrelationship between stocking rate, individual growth rate and overall fish yield. For as long as the amount of natural food exceeds population requirement, an increase in stocking rate will not affect the growth rate. Further increase in stocking rate, however, will increase the population requirement to a point where it can no longer be satisfied by the available natural food and, as a consequence, the growth rate of the individual fish will decrease. Finally, when the stocking rate and population nutritional requirement are so high that the available natural food is simply enough for maintenance purposes, growth ceases entirely. Supplementary feeding in Chanos ponds must aim at further increasing present stocking rates and simultaneously maintaining an average size most preferred in the market.

It appears that increased intensification of fish farming, backed up by a rational feeding program, is a reasonable alternative, on economic and ecological grounds, to the development of more fishponds along tidal swamps, and estuaries. The former argument is given in terms of the present high investment costs in the construction of fishponds, whereas, the latter argument stems from the role of estuaries as potential nursery grounds of several fish and crustacean species that support the local marine fishery (Camacho, 1975). Moreover, the mangrove swamps harbor several species of plants which could be exploited for many unconventional products and which could provide employment and foreign exchange. (Lawas, et. al., 1974).

With this as a background, a review of attempts to incorporate feeding in milkfish culture is in order. Rabanal, et al., (1951) recommended 12-15 kg of very fine rice bran per day as being adequate supplemental feed for 300,000 bangos fingerlings in a one-hectare nursery pond. Fingerlings are found to adapt to the feed only after a few days. It was further noted that this feeding program enables fish farmers to keep a good stock of stunted fingerlings for a period of one year. Abagon, et al. (1951) mentioned the practice of supplementing pond-produced lumut, or filamentous algae, with rice bran, fermented water hyacinth, rice straw, and digman (Najas sp. and Ruppia sp.). They also mentioned the use of Gracilaria confervoides (gulamang dagat) a marine red algae, which in practice were kept alive in the ponds until consumed by milkfish fingerlings. The amount of the algae stocked in ponds was, however, based largely on the judgment of the operator.

Ronquillo, Villameter and Angeles (1957) offered a milkfish supplementary ration consisting of powdered fat-free milk, fine rice bran, and fine corn meal, with or without Vigofac and terramycin additives in quantities less than 1% and 2.5%, respectively. The fry in fortified diets showed the best growth response and the least mortality.

As a salient feature of improved management technique for milkfish culture, Tang (1967) advocated the use of limited quantities of supplemental feed for the protection and replenishment of the desirable algal pasture. He recommended feeding a pelleted ration (20-25% crude protein; 4-8% fat; 10-14% fiber; 40-50% crude carbohydrates) at a rate of 1-2% of the total weight of the fish. The feed formulation utilized at the Brackishwater Aquaculture Center, Inland Fisheries Project for supplemental feeding of Chanos is a mixture of fish meal, copra meal, brewers dried grains, rice bran and binder (bentonite or gelatinized corn grits). The feed was prepared in a pelleted form and contained approximately 33% crude protein, 10% crude fat and 2,200 Kcal/kg/gross energy. Separate feeding trials in ponds stocked with 5,000-10,000 fingerlings per hectare and using a sliding scale of feeding rates ranging from 2-5% of total biomass of fish gave feed conversions greater than 2.0 and were considered uneconomical for practical application. (IFP Tech. Report, 1972). Relatively low growth response of Chanos on the artificial diet was reported to be an indication of poor water stability and marginal acceptability of the pellets. It was observed that some suspended feed particles were readily taken in by the fish, suggesting that floating pellets may be more efficient.

A study on the effects of different pellet formulations on the growth of Chanos post-fingerlings under tank conditions was conducted at the Institute of Fisheries Development and Research, the University of the Philippines (unpublished report). The diets contained crude protein levels of 32%, 23% and 17%, using camote meal (Ipomea batatas), sea cucumber meal and fish meal as the variable components. Kangkong meal (Ipomea aquatica), soya bean and chicken manure, maintained at constant percentages, composed the rest of the ingredients. Results showed that animal protein effected better acceptance and higher growth rate than plant proteins. The best performance was recorded for fish on a diet containing fish meal.

According to a recent report (Felix, 1975), intensive culture of bangos in fishpens using a stocking rate ranging from 30,000-60,000 per hectare required no regular supplemental feeding, except two weeks before harvest to fatten the stock and improve the taste. However, higher stocking rates of 10-20 fish per square meter were found to require regular feeding in the amount of 4-10% of the total body weight at least once a week or depending upon the condition of the fish. Supplemental feeds given were rice bran, old bread, bakery wastes, corn meal, coconut meal, fish meal, dried shrimp, dried chicken manure or combinations of the above.

Role of Basic Nutritional Studies

Optimum balance of various nutrients is important in the formulation of an economical as well as a maximum performance ration. Attention is also directed at giving the minimum amount of feed which will affect the desired rate of gain without polluting the water and thereby causing stress on the fish (Lovell, 1969). As a general rule, growths can only be achieved by fish and other organisms if there is sufficient energy in the food to cope with the metabolic demands of maintenance and other activities associated with feed intake. Thus, optimal feed conversions rest upon an understanding of the biological and environmental factors affecting metabolic rates with a view to reduce the demands of the system (Brett, 1968).

Carefully designed experiments using ponds and indoor facilities will yield vital information on both the qualitative and quantitative aspects of supplementary feeding. Technically, there ought to be no radical departure from the present practice because, in the first place, being herbivorous species, milkfish provides high quality animal protein at the fertilization level of management. However, the magnitude of further increase in production due to feeding and in addition to fertilization has not been fully investigated.

Nutritional studies also aim at increasing fry survival since a serious health problem in fry nursery is possibly undernourishment (Bardach, 1972). The establishment of fingerling banks at strategic places in the country may help fish farmers plan on a minimum of three crops a year with the availability of stocking material during off-season periods. This approach will depend primarily on a program of stunting the fingerlings for several months, with excellent survival, on a strictly maintenance ration. This is an interesting problem from the standpoint of physiology, nutrition and overall culture technique.

Relevant to the present system, nutritional studies may also be directed at shortening the growth period by effecting a high daily growth rate. Finally, in less productive ponds where natural food is a limiting factor in spite of the fertilizer inputs, yield may be directly influenced by the rational use of added feed.

In a fish ration, protein is undoubtedly the most expensive component and this recognition calls for further research since a host of physiological factors affect the optimum level of protein in the diet, namely, energy level and/or protein sparing action of the non-protein components of the diet, the size of the fish, the desired production function, water temperature and biological value of the protein source. In addition, there is a need to look into the actual feeding practices and the various physical forms of the feed.

In fish nutrition work, initial attempts are generally made to establish protein requirements by using purified diets, followed by biological evaluation of cheap protein sources, mainly surpluses and wastes from agriculture, farm animals and other human activity. In the formulation of suitable diets for supplementary purposes, it must be understood that a deficiency in protein develops only when the standing stock or fish biomass exceeds a value wherein the natural food can no longer supply the required protein. Generally, protein deficiency increases with the increase in the standing stock. For this matter, a definite level of protein in the supplementary feed cannot be prescribed and this principle will also apply to the other components of the diet, such as vitamins and minerals, which are likewise provided by the natural food (Hepher, xeroxed copy).

References

Abagon, M.A., O.M. Buñag, and A.M. de Vera, 1951. "Gulamang dagat" as supplementary feed for bangos. Bulletin of the Fisheries

Society of the Philippines. Vol. 2.

Bardach, J.E., J.H. Ryther, and W.O. McLarney, 1972. Aquaculture. The farming and husbandry of freshwater and marine organisms. Wiley-Interscience. New York, London, Sydney and Toronto.

Brett, J.R. 1970. Fish-the energy cost of living. IN; McNeil, W.J. (ed.). Marine Aquiculture. Oregon State University Press. Corvallis.

Camacho, A.S. 1975. Status and needs of fish nutrition. Position paper presented at the PCAR Fisheries Research Congress. March 7-10, 1975. Legaspi City.

Felix, S. 1975. Bangos culture in fish pen. Bureau of Fisheries. Manila.

Halver, J.E. 1970. Nutrition in marine aquiculture. In: McNeil, W.J. (ed.). Marine Aquiculture. Oregon State University Press. Corvallis, Oregon.

Hepher, B. Supplementary feeding in fish culture. Xeroxed copy.

Hickling, C.F. 1962. Fish culture. Faber and Faber, London.

Inland Fisheries Project. Technical Report. March 8, 1971 - June 30, 1972. U.P. College of Fisheries. Diliman, Quezon City.

Inland Fisheries Project. Technical Report. July 1, 1972 - December 31, 1972. U.P. College of Fisheries, Diliman, Quezon City.

Institute of Fisheries Development and Research. University of the Philippines. Study on the relative effect of different pellet formulations on the growth of milkfish, Chanos chanos (Forskal) post-fingerlings. Unpublished report.

Lagler, K.F., J.E. Bardach and R.R. Miller, 1962. Ichthyology. Joh. Wiley and Sons, Inc., New York, London and Sydney.

Lawas, J.M., P. Acosta, J. Ravelo and P.G. Esquieres. 1974. Economic study on alternative uses of mangrove swamps: bakawan production and fishponds. Proceedings of the 15th session of Indo-Pacific Fisheries Council. Oct. 18-27, 1972. Wellington, New Zealand.

Lovell, R.T. 1969. Nutrition in catfish culture; A review. A paper presented at the Ninety-ninth Annual Meeting of the American Fisheries Society. New Orleans, LA.

National Academy of Sciences. Committee on Animal Nutrition. 1973. Nutrient requirements of domestic animals. No. 11. Nutrient requirement of trout, salmon, and catfish. Washington, D.C.

Nikolsky, G.V. 1963. The Ecology of Fishes. Academic Press. London and New York.

Rabanal, H.R., H.R. Montalban and D.J. Villaluz. 1951. The preparation and management of bangos fishpond nursery in the Philippines. The Philippine Journal of Fisheries, Vol. 1 (1).

Ronquillo, I.A., E. Villamater, and H. Angeles, 1957. Observations on the use of Terramycin and Vigofac-enriched diet on bangos fry. Proceedings of the Indo-Pacific Fisheries Council. Vol. 7(2).

Schuster, W.H. 1960. Synopsis of biological data on milkfish. Chanos chanos (Forskal) 1775. FAO Fish. Biol. Synopsis.

Tang, Y.A. and T. Hwang, 1966. Evaluation of the relative suitability of various groups of algae as food of milkfish in brackishwater ponds. Proceedings of the World Symposium on Warm-water Pond Fish Culture. Rome, Italy. FAO Fisheries Report 44 (3).