Proceedings of the Summer Institute in Recent Advances in Finfish and Shellfish Nutrition

11 TO 30 MAY 1987

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
Dr. SALIM ALI ROAD
COCHIN-682 031

Technical Paper - 15

SUMMER INSTITUTE IN
RECENT ADVANCES IN FINFISH AND SHELLFISH NUTRITION

11-30 May, 1987

FORMULATION OF COMPOUNDED FEEDS FOR PRAWNS

SYED AHAMAD ALI

Central Marine Fisheries Research Institute
Marine Prawn Hatchery Laboratory
Narakkal-682505.

INTRODUCTION

Compounded feeds have been one of the essential requisites in the development of aquaculture. Rearing of larvae in the hatchery, postal larval rearing in the nursery until they become stockable size and their subsequent culture in grow-out ponds require appropriate and nutritionally balanced compounded feeds. Compounded feeds have many advantages. By understanding the nutritional requirements of the candidate species of culture, nutritionally well balanced feeds could be formulated using low-cost feedstuffs available in the concerned region. These feeds could be prepared in large quantities with good shelf life and can be used off the shelf wherever and whenver required. Preparation of compounded feed does not require extensive area and highly skilled man power. High efficiency of the feed could be achieved by judicious manipulation of feed ingredients and can be made economically feasible. Dispensing of compounded feeds is quite convenient over large farm areas and automatic feed dispensing devices could be successfully employed.

Compounded feeds are two types. (1) Purified diets for studying nutritional requirements of animals and are generally formulated using purified ingredients, and (2) practical feeds which are formulated using natural ingredients.

In order to achieve the desired performance of a compounded feed, there are many a factors to be taken into consideration. The strategies to be employed in formulating compounded feeds for prawns are discussed below.

SELECTION AND EVALUATION OF RAW MATERIALS

Before formulating a compounded feed for a candidate species of prawn, the feed ingredients which may go into the formula have to be identified. A survey has to be conducted in the concerned region for identifying the materials. Since practical feeds are meant for large scale commercial production, the ingredients selected should be available in large quantities during the required season, the material should have consistant quality and should not be expensive. As far as possible, feedstuffs which are used for human consumption should not be selected for making feeds for prawns. This may create competition for the same material and its cost may go up very high. The selected raw materials should be analysed for their bio-chemical composition of protein, lipid, carbohydrate, minerals (ash) and crude fibre. If the ingredient is a protein source, the quality of the protein can be determined by analysing its amino acid composition. Next the biological evaluation of the feed stuff should be carried out. This could be done by feeding the material in appropriate form to the test animals and measuring the digestibility, growth of the animals and the feed conversion efficiency.

Feed materials may be classified as (1) roughages (2) energy feeds and (3) protein supplements. Roughages are materials with more than 18% crude fibre. Energy feeds are ingredients with less than 20% protein and less than 18% crude fibre. And the protein supplements are feed stuffs with more 20% crude protein.

Using this classification, the selected raw materials can be grouped into energy feeds and protein supplements. Each feed ingredient that is selected for inclusion in the feed formula should have a definite purpose. It should be either a protein source or energy supplement. It may be a good source of lipid, vitamins of minerals. Some times the material may be a growth promoter, an appetizer or may have any other specific function.

Materials of both plant and animal origin are suitable for formulating feeds. These may be agricultural, marine and industrial bi-products or waste materials. Some of the common feed materials are given below:

Energy feeds: Rice bram, wheat bram, tapioca, barley, corn sorghum and maize, fish oil, vegetable oil and animal fats.

Protein supplements:

(i) Plant origin : Oil cakes like, ground nut, cotton seed, linseed gingelly, coconut, rape seed, sunflower and soybean cakes.

(ii) Animal origin : Meat meal, blood meal, fish meal, slaughter - house waste, clam meat, prawn waste, mantis shrimp and silkworm pupa.

Non convertional feed stuffs	:	Poultry bi-products like feather meal, single cell protein like Spirulina, krill and yeast.

BINDING AGENTS AND THEIR SELECTION

The characteristic difference between the feed of homothermic land animals and that of the aquatic animals is that the later has to be provided feed in/under the water column. If the feed, disintegrates and dissolves away in the water, it is not available to the animals. It may cause large scale pollution of the rearing medium. To prevent this, substances known as binders have to be used which provide the feed the required water stability and prevent disintegration. Selection of a suitable binding material is essential and important. A poor binder would result in poor growth and conversion efficiency leading to economic loss. Selection of binder should be done carefully to control the cost of the final feed, at the same time it is effective in binding action.

Agar agar, carboxy methyl cellulose, gelatin, guar gum, poly vinyl alcohol (PVA) sodium alginate and starch are some of the chemical substances which can be used as binders. Wheat flour, rice flour and tapioca are good natural binders which can be used for binding prawn feeds. The criteria for selecting a binder is that a feed prepared using that binder should have good water stability (minimum 3 hrs.), it should not impair the assimilation of the feed and should not unduly enhance the cost of the feed. Tapioca powder is one of the good natural binders in prawn feeds. When added to the feed (upto 40% level) it provides good source of carbohydrate and at the same time acts as the binder. The feed pellets, prepared with tapioca as binder, have good water stability. The pellets when added to water, absorb water quickly and become soft and retain the shape of pellets at least for six

hours. The binding quality of tapioca was comparable to that of agar agar, PVA and sodium alginate. Tapioca is a low cost material available in large quantities. Thus tapioca is a double action material in prawn feeds.

FORMULATION OF FEEDS

Feed formulation is essentially making of a recipe according to the requirements. The selected raw materials have to be fitted into a formula to meet the requirements of the candidate species. Each feed material has to be adjusted to provide a particular nutrient and evolve a formula which can meet the requirement of protein, lipid, carbohydrate and the energy. If necessary additional amounts of vitamin and mineral mixtures should be added. Finally the binder at the required level should be incorporated to make the formula complete in all respects. The simplified flow sheet of feed formulation is given below:

Feed Formulation

NUTRITIONAL REQUIREMENTS OF THE ANIMAL — ENERGY, PROTEIN, LIPID, CARBOHYDRATE — BALANCE — SELECTED FEED INGREDIENTS

+

VITAMINS AND MINERALS

+

BINDER

BALANCED FEED FORMULA

No single feed material is a complete feed by itself. It is always advisable to have multi-ingredient feed formula. One ingredient may be rich in a particular nutrient and deficient in others. A balance of the required nutrients could be obtained only by including more than one ingredient in the formula. Generally animal proteins are more superior to plant proteins for prawns. A mixture of 60% animal protein and 40% plant protein is a good combination in prawn feeds. There is a simple method to balance the requirements (protein or energy, only one at a time) using feed ingredients. This is called the 'Square Method' and is described below.

Example 1: To formulate a feed with 30% protein using two ingredients prawn head (35% protein) and ground nut cake (protein 45%). First a square is constructed and the names of the feed ingredients are written on the two left corners along with the protein content of each.

The required protein level is written in the middle of the square. Next, the protein level of the feed is

Prawn Head (35.0)

Groundnut cake (45.0)

substracted from that of the feed stuffs and the answer is placed in the corner opposite to the corresponding feed stuff, ignoring the positive or negative sign as shown in figure. Now add the figures on the right hand side of the square 5 + 10 = 15. To make the feed with 30% protein we must mix

$$\text{Prawn head } \frac{10}{15} \times 100 = 66.67\%$$

$$\text{Groundnut cake } \frac{5}{15} \times 100 = 33.33\%$$

Example - II

To prepare a feed with 28% protein using five ingredients prawn head (35% protein) mantis shrimp (45% protein) fish meal (60% protein) groundnut cake (45% protein) and tapioca (2% protein), the ingredients are grouped into basal feeds with less than 20% crude protein and protein supplements with more than 20% crude protein. The protein content in each group is averaged and plugged into the square as follows:

Basal feeds : Tapioca 2.0%

Protein supplements: Prawn head = 35.0
Mantis shrimp = 45.0
Fish meal = 60.0
Groundnut cake = 45.0
Total 185.0

Average = 46.25%

Basal feeds 2.0 18.25

Protein supplements 46.25 26.0

Total = 18.25 + 26.0 = 44.25

Now the composition will be

Basal feeds = $\frac{18.25}{44.25}$ X 100 = 41.24%

Protein supplements = $\frac{26.0}{44.25}$ X 100 = 58.76

The final feed formula is:

Prawn head	=	$\frac{58.76}{4}$	= 14.69%
Mantis shrimp	=	$\frac{58.76}{4}$	= 14.69%
Fish meal	=	$\frac{58.76}{4}$	= 14.69%
Groundnut cake	=	$\frac{58.76}{4}$	= 14.69%
Tapioca			= 41.24%
			100.00

Thus the feeds can be formulated using the selected ingredients by balancing the nutrients like protein. This method can be used to balance energy content of the feed. In the place of protein values, energy values have to be used.

FEED FORMULATION BY LEAST-COST APPROACH

Least-cost feed formulation or Linear programming (LP) was first introduced to the animal feed compounding in mid fiftees. Recently it has been introduced in fish feed formulation also. LP is a mathematical procedure by which limited resources are allocated to achieve an optimal solution to a particular objective. These operations are completely computerized and a detailed information regarding the ingredients is needed before attempting it.

In formulating feeds by LP, the nutritionist, first lays down a set of constraints, and then lists all available raw materials which he wishes to be considered for selection by the computer to achieve the objectives. The objective is least-cost feed that will satisfy all the constraints.

The digestibility coefficients and other nutrient composition of ingredients along with constraints are supplied to the computer in its proper form. The computer will analyse and would be able to give the formula with the desired objectives. This could be achieved only when the nutritional requirements of the candidate species are known in total and the nutrient composition of the ingredients is thoroughly analysed.

The least-cost approach will become relevant and useful only when the operation of feed production is very larger. But with limited knowledge in prawn nutrition, over emphasis on the least-cost formulation of feeds could be premature. However feed cost is the single largest expense (35-50%) in prawn production. The unit price of prawn feed is relatively higher. Any saving in the feed cost by least-cost approach for LP will help the prawn culture industry.

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