ADVANCES IN TROPICAL AQUACULTURE Tahiti, Feb. 20 - March 4, 1989.
AQUACOP IFREMER Actes de Colloque 9 pp. 405 412.

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Selected ingredients for shrimp feed.

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Abstract. — *The selection of ingredients is a high priority for formulating and processing shrimp feeds. One of these selected ingredients is fishmeal which represents 30-40 percent of the whole formulae. It is reviewed some specifications on fishmeal quality in order to determine which one is the best among white and brown fishmeal.*

Another ingredient of major importance is soyabean meal which can repleace part of fishmeal only. It seems important to select a good quality soyabean meal.

Yeasts are a potential source for protein supply and benefits for shrimp growth are substantial. But again the response of the animal is in relation with the quality of the product (lactic yeast versus brewers yeast for example).

As a last example of selected ingredients is shrimp meal which has long been representing a major component in shrimp diet with levels of inclusion as high as 30 percent. The real benefit of shrimp meal in a diet is discussed.

A short review is given on other ingredients like, squid meal, mussel meal and leaf protein concentrate, casein and gelatine.

INTRODUCTION

There are many ways to start up with a species for which a good nutrition is required.

So far the knowledge on ingredients is of prime importance for the formulation of shrimp diets, as far as multi-ingredients formulae are concerned. In case of purified diets some protein sources like casein, albumin, gelatine, have been proved successful (Kanazawa, 1972; Deshimaru, 1975) and more recently crab protein (Boghen et *al.*,1982; Castell, 1987) which is about to be used as a reference protein source.

Artificial diets are composed of several ingredients including squid meal, fish meal, yeast,.(Deshimaru, 1974; Shigueno, 1975, Aquacop, 1976).

It is the intermediate step before formulating commercial feeds in which fish meal represents the major component (Table 1).

MATERIALS AND METHODS

Most of experiments are conducted in 250 litres tanks as previously described (Aquacop, 1976, 1978, 1986), and standard conditions are obtained for the seawater, temparature, salinity, oxygen, pH, N-NH3, N-NH4, N-NO2.

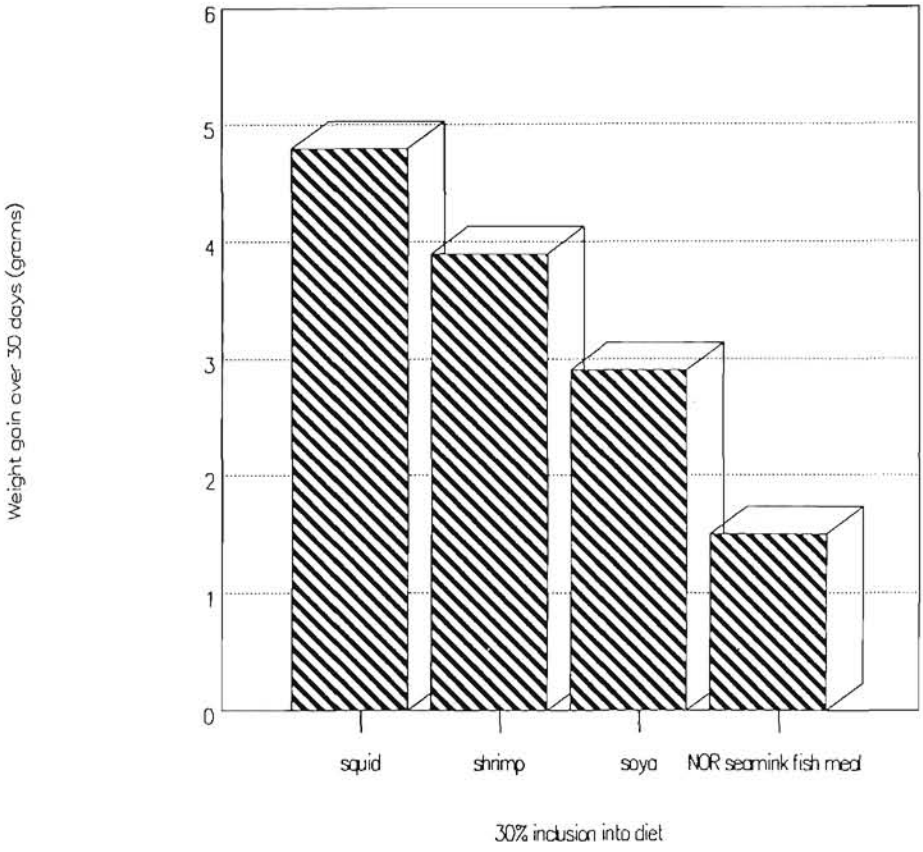


Fig. 1. — Comparison of the effectiveness of protein sources on growth of *P. stylirostris.*

RESULTS

Each ingredient is tested for its efficiency when included at a relatively high level in the feed, at least 30 %. And each protein source ingredient is compared to another in order to get a classification of these protein sources ingredients.

This method is not a precise one and it needs to collect other data to state clearly on each ingredient considered as a protein source (Fig. 1).

Nevertheless, indications given by such a procedure are proved to be useful for the formulation of artificial feeds.

All these studies on classification of raw ingredients for the diet of shrimp in order to select the most productive ones for growing animals are conducted with an average protein level generally well above the determined optimum level, in order to be sure no limiting effect results on a given amino acid of the diet (Table 2).

	%
CPSP 80	15
Wheat gluten	20
Wheat flour	15
Blood meal	3
CaHPO4	3.5
Oyster shell	0.5
Cellulose	2.5
Fish oil	1.75
Lecithin	1.75
Potato starch	3
Vit. mix.	4

Table 1. Basal diets for ingredients study on *P. stylirostris*.

Table 2. Proximate analysis and amino acid composition of experimental feeds according to the selected protein source in g/100 g.

	Norsea mink meal	Soy Concentrate	Squid meal	B/B Shrimp meal	CPSP 80	Caseine
ARG	3	4	3	2	3	3
HIST	1	2	1	1	1	2
LYS	3	3	3	2	3	3

DISCUSSION

Establishment of protein requirements within a system must be on the quality of the protein source (Colvin and Brand, 1984); when studying for protein requirement of PL's of *P. Californiensis*, they concluded at an optimum around 30 % when feed conversion ratio was improved regularly from 30 up to 40 % of the diet.

One can wonder if higher protein level have promoted better growth and consequently better feed conversion ratio ?

In the case of *P. Vannamei* raised experimentally at COP or in commercial ponds, it has been shown an evolution of growth rate according to concentration of protein in the feed. In early seventies, the marine ration 25 was used (Ralston Purina), in semi intensive conditions, commercial rations provided to shrimp raised in ponds with natural productivity.

Growth performances were satisfying with around 3-4 g, average weight increase per month. Then, early 1980's, a commercial feed (President shrimp feed) 40 % higher in protein provided better growth rates in

experimental tanks, 3-4 g per month without natural productivity. At last, more recently, 1984 onwards, another commercial feed, a Japanese one (Nippaï shrimp feed) was successfully experienced in order to reach what could be called maximum growth, i.e. 6 g average weight increase per month. Such an evolution underlines a real discrepancy between optimum of protein in a shrimp feed, for economical reasons and optimum of protein for maximum growth of penaeid shrimp. Such a statement is more accurately demonstrated thanks to the following experiment (Cam, Cuzon and Aquacop, 1989).

An appreciation of ad libitum feeding level allows to calculate several levels of restricted feeding and correlate this to growth performances of *P. Vannamei* over a month.

A relationship is clearly shown between the amount of ingested feed and growth performances. One distribution versus two distributions of extruded feed help to understand the growth improvement of 1 or 2 grammes weight increase over a month when two meals are provided instead of one Meanwhile, feed conversion ratio is approximately constant at 2.2 and slighlty improves when two meals are given, FCR = 2.1.

Another study on *P. japonicus* (Deshimaru, 1972) gave similar results = relationship between ingested level of feed and growth rate in one case, improvement of FCR with increase of protein in the diet in another case.

« The overall capacity of the gastro intestinal tract to digest protein is very high since levels of protein up to 60-70 % of the diet are apparently digested as well as are lower levels. It seems to be difficult to exceed the digestive capacity of an animal with a diet composed of readily digested components » (Nesheim, Scott and Young, 1982).

Aside the research for optimum combination of ingredients for maximum growth of penaeid shrimps, one of the other aspect of applied nutrition of the shrimp is the effectiveness of a given raw ingredient on growth and survival of shrimp.

It is the case with two major components of shrimp feed, soya bean meal and fish meal.

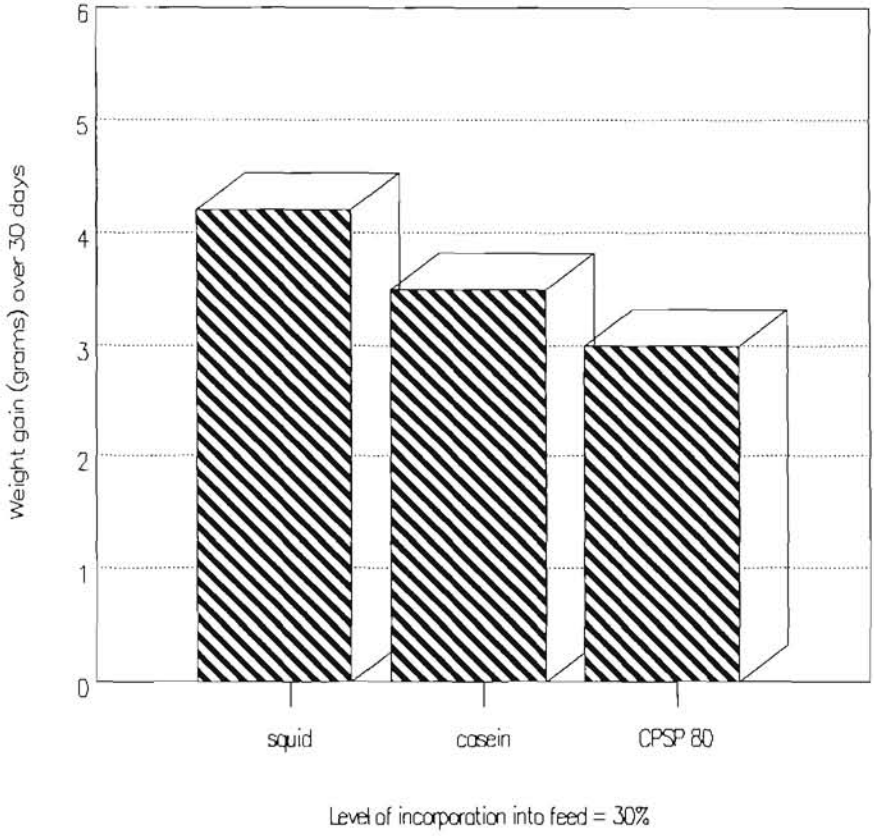
One of the techniques involved is what is called dose-response test for one ingredient in case of US soya bean meal, a range of 5 to 20 % is calculated at the expense of a combination of protein sources (FPC, shrimp meal, yeast, blood meal).

There is isoproteic value and isoenergenetic value of the 4 formulae. A one month growth test trial shows a regular decrease of growth performances when soya bean mean replaces the combination of other protein sources when no stunted growth was expected (Aquacop, 1983) unpublished results.

There is a possible indication of antinutritional effect of large amounts of soya bean meal in *P. vannamei* feeds for juveniles though some experiments on post-larvae seem to indicate a possible high level of soya-bean meal into the feed (A.D. Lawrence, 1988).

A second ingredient of importance is fish meal which has long been representing a major ingredient of fish and shrimp diets.

In Tahiti, a selection of Norway fish meal was done in 1983 and in order to check its influence at relatively high level in the feed of *P.*



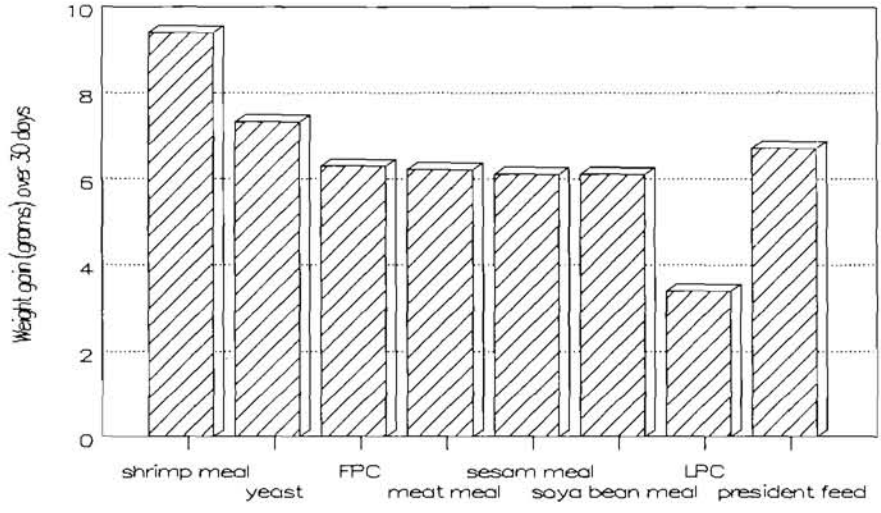


Fig. 2. — Comparison of protein sources for *P. monodon.*

vannamei, according to a similar protocole as the one used for soya bean meal test. The replacement of a mixture of other ingredients by Norway fish meal in *P. vannamei* feed do not affect growth rate of shrimp up to 20 % inclusion. Beyond that level, a slight negative effect is observed and it is explained by the fact that quality of Norway fish meal does not compensate the mixture quality of other ingredients, including fish protein concentrate. Formulations of shrimp feeds are exhibiting large amounts of fish meal. Japanese manufacturers are selecting white fish meal with low histamin content for *P. japonicus*.

Ecuadorian manufacturers are largely relying on local supply of regular fish meal for producing feeds for *P. vannamei* raised at low density in large ponds.

Taiwanese manufacturers import fish meal from Japan and especially from Indonesia, Perou, Chili in order to keep up their formulations for *P. monodon* at around 40 % crude protein. They emphasized a lot on criteria for selection of quality fish meals and they produced in 1985 a table given for classification of fish meal of different origins. This classification enables us to separate brown fish meal from white fish meals. Such data should be more widely distributed for helping manufacturers to select more precisely their stocks of fish meals for producing their shrimp feeds.

It is the case in Tahiti and New Caledonia where 7 differents spots can be considered in the South Pacific Area to select a supplier of fish meal.

More over other protein sources are essential for the production of shrimp feeds, there are shrimp meal, yeast, squid meal, mussel meal. Various qualities of shrimp coming from Louisiana, Alaska, Ecuador, Groënland principally where tested at same level inclusion in a shrimp diet with same growth performances.

The raw material seems highly dispensable in a shrimp feed and that was shown at 30 % level inclusion in a *P. monodon* diet in comparison with several other protein sources at same protein content, shrimp meal allowed shrimp to grow faster, yeast were coming right after. Yeast is another ingredient which has good potential regarding to the growth of shrimp; some commercial feeds are probably including up to 20 % of the whole formulae. Again its quality is strictly related to growth performances of penaeid shrimp (Fig. 2).

At last, molluscs meals are of prime importance, mussel meal, and especially squid meal (Cruz et *al.*, 1986; Cruz et *al.*, 1987) which seems to act as a growth promotant on several shrimp species. It is worth talking of a squid effect which could be a more general mollusc effect related to shrimp growth.

CONCLUSION

The good knowledge on major ingredients and adequate supply of quality raw materials help dramatically to formulate and produce shrimp feeds with a good potential for growth. One of the best example is given

with Taiwanese Practical feeds for *P. Monodon* (Chuang, 1988) which includes 30-40 % fish meal, 7-15 shrimp meal, 5-15 % soya bean meal, fish solubles and squid liver, cereals and premixes. In order to summarize all this information, a table of selected ingredients for shrimp feeds is established (Table 3) and will be revised annually according to specifications given by a Nutrition Working Group.

Table 3. Selected ingredients for shrimp feeds.

1. Fish meals. Marine protein	
NSM	10-25 %
WFM	
Tuna Fish meal	
Chilean Fish meal	< 40 %
Peron Fish meal	< 20 %
Alaska Fish meal	
NZ Talley Fish meal	15 %
Fish protein concentrate	8-20 %
2. Shrimps meals	
Blum and Berjeron	30 %
Alaska	30 %
Ecuador	30 %
3. Squid meal	
Japan	5-40 %
India	5-40 %
4. Yeasts unicellular proteins	
Lactic yeast	20 %
Torula yeast	< 15 %
Brewers yeast	10-15 %
Bakery yeast	20 %
5. Meat/bone meal : Conventional protein sources Blood meals	
MBW 48 % cp	< 15 %
Blood meal	
- drum dried	3-4 %
- atomized	10 %
Chicken of falls meal	10 %
6. Soya bean meal	
Regular SBW 48 % cp	20 %
Soy protein concentrate	10 %
7. Leaf Protein Concentrate	< 6 %
8. Wheat Gluten	5-20 %

All this information should be more and more available and accurate in order to allow the use of a linear programme with more and more insistance; that would be particularly helpful for feed manufacturers.

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