# PRODUCTION OF FEEDS TO SUPPORT SHRIMP FARMING IN TAHITI (FRENCH POLYNESIA)

AQUACOP *

ORERO BP 20 PAPEETE TAHITI FRENCH POLYNESIA

CNEXO-COP BP 7004 TARAVAO TAHITI FRENCH POLYNESIA

ABSTRACT

Shrimp production mainly of Macrobrachium rosenbergii but also of peneids is now starting on a commercial basis in Tahiti. This production is sustained by conjugated efforts of Service de l'Economie Rurale, Office de la Recherche et des Ressources Océaniques (ORERO) et Centre Océanologique du Pacifique (COP). Different kind of feeds have been developed and produced.

A larval dry feed is operational, complementary to Artemia nauplii. A viscous finely ground paste (80 % moisture) obtained by mixing fresh ingredients, oils and alginate is extruded throughout a 2 m/m die in a coagulation bath (Ca ++). Fibre obtained by this process are dried, ground and sized. Particles 0,2 to 0,7 mm in diameter are little soluble in water and save near 50% of Artemia cysts during PL'S M.rosenbergii production cycle.

Pregrowing feeds for juveniles until 2g are formed by a granulating press with moistened meals (40% moisture) without heat. This process produces small pellets (1 mm diameter) more water stable than crumbles, giving a good preservation of vitamins and lipid freshness.

Grow-out feeds are processed by cooking extrusion (25% moisture). Two diets : one for M.rosenbergii, one for P.monodon computerized at least cost by linear programming are produced by a local feed mill plant on an ANDERSON Cooker-extruder (pellet diameter : 2,5 and 3,5 mm) which has been set up for this purpose.

## INTRODUCTION

To develop the shrimp culture in Tahiti, mainly Macrobrachium rosenbergii but also peneids, the "Service de l'Economie Rurale", the "Office de la Recherche et Ressources Océaniques (ORERO)" formerly Service de la Pêche and the Centre Océanologique du Pacifique (COP) have conjugated their efforts to decrease the importations and to produce locally the whole set of feeds for the different phases of the culture : larval, pregrowing and grow-out feeds. Research activities are covering different aspects like nutritional requirements, growth tests, feed formulations by least cost analysis and technology.

This paper describes briefly the techniques and the tools which have been developed to fit the low level of production of the initial phase.

## MATERIALS AND METHODS

The larval feed is prepared from a mixing of fresh ingredients like egg yolk, shrimp and squid flesh etc... oils and alginate which are finely ground and extruded throughout a 2 mm die in a coagulating bath of sea water with $Ca^{++}$ (5g/l). This technique is based on the calcium alginate reaction to bind the different components (Meyers 197 ; L'HERROUX et al, 1976). The "spaghettis" are dried then ground, sifted and the obtained particles can be stored for many months. The different sizes of particles used for Macrobrachium culture are given (table 1). When given in the tanks the dry particles rehydrate and stay water stable.

The starter feeds are used from PL'S to juveniles weigh ing 1 to 1.5g in average. It is prepared with a wet pelletizer already described (Aquacop, 1979) and water stability is obtained by the action of wheat gluten at a level of at least 7% in the formulae. Technological parameters are : a low pressure, a low temperature ranging from 40 to 60°C and a moisture content of 35 to 40%. So drying must occur next, in order to decrease moisture content at around 8 %. Fluid bed drying appears quite efficient and it is recommended at a pilot scale.
As pellets obtained with KUSTNER apparatus can operate in the following diameter size range = 1 mm, 0.8 mm, 0.6 mm and 0.4 mm, crushing operations are not necessary.

The grower feeds are manufactured in an existing chicken feed plant where a cooker-extruder ANDERSON 4 ½ inches and a fluid bed dryer Arthur WHITE are settled down. The main parameters of the extruder are the following for the formulae given in table 3 : temperature, 93°C ; high pressure ; moisture 20-25%, feeder index 3 and yield : 200 to 300 kg/hour.

All the feeds are controlled at the laboratory. Mean values are given in table 1 and 2.

## RESULTS

It has been developed a certain number of larval feeds for M.rosenbergii, among them, one(table 1)is giving pretty good results : 70 - 90% survival rate at metamorphosis when mixed with Artemia nauplii. Some particles of smaller size (60 microns) are tried on penaeid larvae at zoeal stages.

Pregrowing formulae allow to get juveniles between 1 and 3g average weight according to species with conversion ratio of 1.3 to 1.5 and a stocking density of 100 PL'S per square meter, sometimes more with P.indicus.

Grow out feeds formulae are specially designed for each species. The Macrobrachium formulae supports productions of 2 to 3 metric tons/ha/year of 20g. animals. The peneids formulae allow productions of 2 to 4 tons/ha/year of 20g animals at densities ranging from 5 to 20/square meter in earth ponds and 20 to 40 tons/ha/year extrapolated from 10 $m^3$ tanks at high densities with species like P. vannamei or P. indicus.

At the laboratory, proximate analysis are run on a routine basis and results associated with formulated feeds (table 2). Moreover, regular controls on water stability and loss of dry matter are done on the various feeds tested or produced (see below) :

| % loss dry matter per hour / type of processing | Alginate particles | Wet pelletizing | Cooker extruder | Pellet mill |
|---|---|---|---|---|
| 0 | X | | | |
| 10 | | X | X | x |
| 20 | | | | x |
| 30 | | | | |

Alginate particles produce the best pellet from the water stability point of view ; starter and finisher shrimp pellets wet pelletized or cooking extruder appear similar while pellet mill operation is slightly less efficient.

## DISCUSSION

One of the major consideration for formulating and producing shrimp feeds is to get what is called a water stable pellet. Emphasis has already been made on this item by numerous authors (MEYERS, 1970). The water stability indicates the fact that the shape of the pellet is kept after one hour in sea or freshwater ; another aspect quite more important is the leaching which affects soluble compounds like fish solubles, fish protein concentrate, vitamines, etc... Such phenomenon is measured when considering the loss of dry matter after one hour sojourn into water.(Cuzon et al., 1982).

Generally speaking, the smaller the size of the shrimp is the more water stable and the less leaching out should be the feed. With Macrobrachium larvae, microparticles are used starting at Zoeal stage 6 up to metamorphosis as a complement of Artemia nauplii ; but compare to initial alimentary scheme where all larval stages were fed on Artemia nauplii plus a little of bonito flesh, alginate particles allow to save a significant amount of Artemia and keep the water free of a heavy organic pollution. With further improvements on its nutritive value, one can reasonably figure out that future PL'S productions will sustain for a major part of the cycle on alginate or other kind of fully nutritious particles. Selling price could be at around 30 US $/kg, some other types of particles could be prepared including rehydratable diets (Guillaume et al., 1982).

About 10 years of continuous effort (AQUACOP, 1976; 1977; 1978) were necessary to get a convenient pregrowing feed for shrimp or freshwater prawns and composition of the diet is still being improved. One can afford a rather high price for such a diet, presently 1 US $/kg as limited quantities are requested, and as farmers are willing to get their juveniles as fast as possible to fill the grow-out ponds.

Concerning pellets used to get the commercial size of shrimps, first fresh water prawn feed has been developed in Tahiti (Aquacop, 1976) including a large amount of vegetable protein sources : coprah meal or leucaena meal with pretty good results. Then, in order to cope with economic context of French Polynesia, wheat gluten was replaced by corn ,allowing to get the pellet from cooker-extruder instead of the KUTSNER pelletizer. Such diet (table 3) can sustain crop of 2 metric tons of *Macrobrachium*, at 20g, per year with conversion ratio of 3 : 1 . Improvements could still be made on the cost of pellets : reducing it by least cost formulation (BARBIERI and CUZON, 1978) can bring pellets at around 56 cents/kg for *M.rosenbergii* up to 72 cents/kg for peneids or by the use of pellet mill processing system which is a lower energy demander and without drying operation. Such way is under study (GOUBY, 1982), and could facilitate the transfer of production in existing chicken feed plant.

In Tahiti where the salinity is about 35 ppt and the natural productivity very poor it is necessary to have the best quality pellets. Right now, in clear water testing tanks the growth is always inferior to the growth obtain in ponds. It means something is lacking in the diet leaching effect is still too important ; this is probably due to technological problem. The other problem is related to the quality of ingredients which hamper the nutritive value of the feed :some ingredients contain toxic compounds like peroxides, ... or some other do not bring enough essential nutrients (VALO, 1980).

Other considerations concern, storage in tropical climate of shrimp feeds : nutrients like lipids, vitamins, are primarily affected by storage under a long period, including transportation. At a larger extend, some fungus appear on pellets if moisture content is too high. All these problems are encountered in Tahiti where time of delivery is too long, therefore it was necessary to produce locally pelleted feeds with ingredients like vitamins, oils, introduced after a good storage.

It was not convenient to receive shrimp feeds from abroad by ship due to the time of transportation.

At present it is produce some 10 metric tons of extruded feed per month in a chicken feed factory at Papeete and researches are done to find a way to produce shrimp feed through a pellet mill to get lower cost pellet and enough water stable pellet for shrimps. Actual cost is around 80 cents a kilo and some 20 metric tons are exported to other islands of the South Pacific where aquaculture projects are starting (Fiji, New-Caledonia).

## CONCLUSION

To start a shrimp farming in small countries where the level of feed production will remain low specially during the initial phase, it is necessary to develop original tools to minimize the investment and be able to produce locally at a reasonable cost. All the techniques developed here can be easily applied to a high production level as it is needed for developing countries with a high potential for export market.

## LITERATURE CITED


Aquacop, 1976. Incorporation de protéines végétales dans un aliment composé pour crevettes M.rosenbergii. Aquaculture (8) : 71 - 80.

Aquacop, 1976. Résultats expérimentaux sur P.japonicus. Spécificité et besoins en protéines. Importance des acides gras FAO - KYOTO - E 42.

Aquacop, 1977. Reproduction in captivity and growth of P.monodon in Polynesia. 8th Annual Meeting WMS p. 927 - 945.

Aquacop, 1978. Study of nutritional requirements of P.merguiensis. 9th Annual Meeting WMS, Atlanta - p. 225 - 233.

Aquacop, 1979. Equipments pour fabriquer des granulés par voie humide. Symp. Fish. Nutr. Fish. Techn. Hamburg. p. 143 - 149.

Barbieri and G. CUZON, M.A., 1980. Improved nutrients specification for linear programming of penaeid rations. Aquaculture, (19) : 313 - 323.

CUZON et al., 1982. Time lag effect for feeding on growth of shrimp. Aquaculture (28).

GOUBY, F., 1982. Elaboration d'un aliment pour crevettes par agglomération. ENITIA/Nantes. Rapport fin études 39 p.

GUILLAUME et al., 1982. L'aliment rehydratable pour larves et juveniles de poissons marins et de crevettes. Oceanis (sous presse).

L'HERROUX, 1977. Remplacement des herbivores proies par des microparticules inertes : une application à l'elevage larvaire de P. japonicus 3rd ICES working group on Mariculture. Actes Colloq. CNEXO. 4: 147-55.

MEYERS, 1970. Nutrition of marine crustaceans. Report of 1970 workshop on fish feed technology and nutrition, Stuttgart, Arkansas.

VALO, P., 1980. Contribution à la connaissance zootechnique de l'espèce P.japonicus en vue de la production d'un aliment commercial. Mémoire ENSA/Rennes. 180 p.

Table 1. - ALGINATE PARTICLES FOR M.ROSENBERGII LARVAE

| | RAW g. | ACAL % dry matter |
|---|---|---|
| Whole eggs | 660. | 40 % |
| Whole shrimp | 324. | 10 % |
| Fish eggs | 108. | 5 % |
| Pig liver | 960. | 25 % |
| Soy lecithine cod liver oil | 30. | 5 % {33 % lecithine soja, 66 % cod liver oil} |
| Vitamines | 13. | 2 % |
| Sodium alginate | 86. | 13 % |
| | 2181 g. | 100 % |
| Solution $Cl_2$ Ca : | | 5 g/l |

Proximate analysis :

| | |
|---|---|
| dry matter | 93 % |
| protéines | 47.5% dry basis |
| lipides | 25.3% " |
| NFE | 19.2% " |
| ashes | 8 % " |
| | 100 % |

SIZES OF ALGINATE PARTICLES FOR M.rosenbergii larvae.

| Size of particules | Zoeal stages | Age in days | Quantitites to produce a number of 1 million PL'S |
|---|---|---|---|
| 315 - 400 microns | 5 | 10-12 | 875 g |
| 400 - 500 " | 7 | 15-18 | 1625 g |
| 500 - 630 " | 8 | 18-35 | 2500 g |
| | | | 5000 g |

Table 2. - COMPOSITION OF STARTER SHRIMP FEEDS MADE IN TAHITI.

| INGREDIENTS | SHRIMP FEED | FRESH WATER PRAWN FEED |
|---|---|---|
| | % | % |
| Soya bean meal | 25 | 8 |
| Coprah meal | 2 | 20 |
| Wheat flour | - | 15 |
| Wheat gluten | 7 | 5 |
| Alfafa meal | - | 3 |
| Spirulina powder | 2 | - |
| Shrimp meal | 15 | 10 |
| Fish meal | 10 | 10 |
| Fish protein concentrate | 5 | 5 |
| Fish autolysate | 10 | - |
| Blood meal | 3 | 2 |
| Meat and bone meal | 10 | 10 |
| Fish oil | 5.4 | 4.5 |
| Soy Lecithin | 0.6 | 0.5 |
| Mineral mixture | 3 | 5 |
| Vitamin mixture | 2 | 2 |
| | 100 | 100 |
| Proximate analysis % dry basis | | |
| Dry matter | - | 92 |
| Protein (Nx6,25) | - | 42 |
| Lipids | - | 7 |
| Ashes | - | 18 |
| NFE (by difference) | - | 33 |
| | | 100 |

Table 3. - COMPOSITION OF SHRIMPS FEEDS MADE AT TAHITI.

| INGREDIENTS | SHRIMP FEED | FRESH WATER PRAWN FEED |
|---|---|---|
| | % | % |
| Corn meal | 13.5 | 30 |
| Soya bean meal | 25 | 20 |
| Coprah meal | 10 | 20 |
| Meat and bone meal | 15 | 10 |
| Shrimp meal | 10 | 5 |
| Fish meal | 11 | 5 |
| Fish protein concentrate | 6 | 2 |
| Vitamins | 2 | 1 |
| Minerals | 2.5 | 3 |
| Fish oil | 4.4 | 3.5 |
| Soy Lecithin | 0.6 | 0.5 |
| | 100 | 100 |
| Proximate analysis : % dry basis | | |
| Dry matter | 92 | 93 |
| Protein (Nx6,25) | 42 | 34 |
| Lipids | 8 | 7 |
| Ashes | 18 | 13 |
| NFE (by difference) | 32 | 46 |
| | 100 | 100 |
| Watter stability % loss/hour | | |
| Dry matter | 12 | // |