The Guaymas Shrimp Bycatch Program: Marketing and Industrialization Experience

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RESUMEN

El programa de investigación y desarrollo que se lleva a cabo en el ITESM, Guaymas, ha demostrado la factibilidad de convertir los pequeños pescados de la Fauna de Acompañamiento del Camarón (FAC) en una serie de productos elaborados a partir de su pulpa deshuesada, para consumo humano. En base a estos estudios, se han elaborado diferentes diseños industriales para la recepción y procesado de la FAC, al igual que se han llevado a cabo diferentes pruebas de mercado de algunos productos desarrollados. Pruebas del tipo "localidad central" así como las de tipo "uso dentro del hogar" han demostrado un mercado potencial para los productos deshuesados de la FAC. También se han llevado a cabo análisis financieros de los modelos industriales y estos han indicado que los productos de la FAC pueden ser comercializables en la región a costos considerablemente más bajos que los de productos competitivos. Además, los sistemas diseñados de utilización de la FAC permitirán el pago de la materia prima a precios lo suficientemente altos como para que sirvan de incentivo a los pescadores y que traigan a tierra el pescado que actualmente es desperdiciado. El presente artículo resume las experiencias en estas áreas y describe el diseño de una planta piloto que próximamente será instalada en Guaymas, con el fin de demostrar la utilización comercial de la FAC en la región.

INTRODUCTION

Studies during the initial phase of the ITESM/TPI bycatch program have resulted in the development of several technologies for the utilization of the bycatch in dried-salted, frozen or canned forms. On the basis of these development studies, it is now possible to propose industrial operations for converting the bycatch into a variety of products for human consumption with additional usage of processing wastes as animal feed (fish silage). Basically, two distinct industrial models have been formulated, the processing and financial details of which are fully described in two technical reports (Street, Young and Crean, 1980; Young and Marter, 1981). The initial design (Model I) is an industrial profile for the processing of bycatch fish into a dried-salted deboned mince product for human consumption with waste material being converted into silage. The later design (Model II) is an industrial profile for a demonstration plant (also intended to operate commercially) to process bycatch fish into a wider variety of products, including not only salted-dried mince and silage but also frozen and canned products.

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Model I Plant: Dried, Salted Fish Mince-Silage

The Model I plant was designed to utilize 100% of the bycatch fish landed (Street, Young and Crean, 1980; Young, 1980). The throughput of the production line is limited by the cooking-dehydration process such that a daily output of approximately 1.3 tons of dried-salted fish cakes would result. Fish would be gutted manually and the required input of fish would be 8 tons/day. Shrimping vessels supplying the raw material would return 2 tons/vessel from each trip of 10 days duration. This should be well within the capability of any shrimping vessel and would amount to recovery of fish from the final trawls.

The plant would require the unloading of four vessels daily to maintain an adequate raw material supply. A total of 40 vessels might therefore be involved in the operation given their average 10-day voyage. Assuming that manufacturing could proceed for 294 days/year, a plant of this size would utilize a total of 2,350 tons of bycatch fish annually to produce 382 tons of dried fish cake (i.e., 8.5 million, 45-gram cakes per year). Waste material (heads, viscera, bones and skins) would be processed into silage. The yearly output of byproduct, in the form of wet silage for animal feed, would be 1,352 tons.

The costings applied to Model I relate to an operation where all establishment and management costs are born by the enterprise. In practice, such a process could be appended to an existing fish processing plant which would reduce land, building and management costs. Establishment costs for this process amount to 22.34 million pesos (1980 prices). Operating costs, calculated net of raw material costs, are 7.5 million pesos/annum.

The objective of the financial analysis applied to this industrial model was to provide estimates of the "break-even" factory gate selling prices for products under various assumptions concerning raw material and capital costs.

Table 1. Break even selling prices for dried salt/fish cakes manufactured by Model I at an opportunity cost of capital of 20%*

Price Raw Material (Pesos/ton)	Product Selling Prices	
	(Pesos/kg)	(Pesos/cake)
0	22.13	1.00
2000	34.43	1.55
4000	46.74	2.10
6000	59.05	2.66

* It is assumed throughout that the silage by-product may be sold for animal feed at 3000 pesos/ton. Source: Street, Young and Crean (1980).

This permits the financial viability of the processing operation to be assessed and the market potential of the product to be evaluated when appropriate profit and distribution mark-ups are added.

Table 1 shows the break-even selling prices calculated for dried-salted fish cakes. It may be seen that for the most optimistic assumption, i.e., for a zero raw material cost and a silage value of 3000 pesos/ton, which is competitive with that of other protein feeds, dried-salted fish cakes could be sold for 1.00 peso each (if capital were borrowed at 20%). At the other extreme, if raw material cost 6000 pesos/ton, the same cakes would have to be sold for 2.66 pesos each at the same interest rate. It should be noted that these prices are based on a unit weight per dried cake of 45g (containing about 22g protein). When reconstituted in water, the weight increases to 130–150g and the composition approximates to that of fresh fish. Taking this into account, even the most costly cakes are many times cheaper than other animal protein foods, as will be discussed later.

Model II Plant: Dried-Salted, Frozen, Canned Fish Minces-Silage

All stages of the Model II process prior to and including meat and bone separation are identical to those proposed for Model I. The input of fish would again be 8 tons/day and raw material would be landed in the same way. However, in this case, the annual input of 2350 tons of fish would be processed into the following items: 138 tons/year dried-salted fish mince, 388 tons/year frozen breaded fish sticks, 459 tons/year canned fish "picadillo," (or 514 tons/year canned fish sausage, or 514 tons/year canned fish pate) and 1323 tons/year wet fish silage.

Full details concerning building requirements, product handling within the plant, equipment specifications and water and energy usage are provided by Young and Marter (1981).

The nature of this industrial model obviously offers possibilities for combining different product mixes, given that six end-products are under consideration. Thus, total establishment and annual operating costs for Model II vary between 25.06–26.76 and 19.39–29.20 million pesos respectively depending on the combination of end-product lines installed. The main plant (or buildings and processing stages up to and including mechanical deboning) is responsible for the major proportion of establishment and operating costs. Of the end-product lines, the drying-salting, freezing and ensiling processes are the least expensive to install and operate. Canning is somewhat more costly in both respects. In particular, fish sausage production requires the greatest expenditure in view of additional equipment items required for emulsion formation and filling and the increased demands for labor and consumable goods, such as cellulose casings. For all the canned products, the cans themselves represent the major operating cost item, comprising 62–80% of the total cost of consumable goods.

Table 2 shows the derivation of end-product break-even prices for the Model II system. It may be seen that the break-even price for dried-salted fish cakes under different product combinations is closely similar, i.e., approximately 51 pesos/kg. Frozen fish sticks are around 22 pesos/kg. Of the

Table 2. Break even prices for end products within selected combinations of end product lines: Model II

End Product	End Product Option*	Volume Produced (Ton/yr)	Break-even Price/kg†	Break-even Price/kg§
Fish Cakes	(A)	276	50.97	62.46
Fish Cakes	(B) (C) & (E)	138	51.43	62.93
Fish Cakes	(D)	138	51.45	62.95
Frozen Fish Sticks	(A) to (E)	388	21.99	26.09
Canned Picadillo	(B)	459	24.76	28.23
Canned Sausages	(C)	514	33.36	36.45
Canned Paté	(D)	514	25.92	29.00
Canned Products	(E)	496	28.70	31.91
Silage	-	1,323	2.14	2.14

* Options: (A) Two lines producing dried-salted fish cakes and one line producing frozen fish sticks, (B) One line producing each of the following: fish cakes, fish sticks and canned "picadillo," (C) One line producing each of the following: fish cakes, fish sticks and canned fish sausage, (D) One line producing each of the following: fish cakes, fish sticks and canned fish paté, (E) One line producing each of the following: fish cakes, fish sticks and all three canned products.

† At a raw material cost of 3000 pesos/ton.

§ At a raw material cost of 5000 pesos/ton.

Source: Young and Marter (1981).

canned products, "picadillo" is the cheapest at approximately 25 pesos/kg followed by pate and fish sausage at around 26 and 33 pesos/kg respectively. These prices assume a raw material cost of 3000 pesos/ton.

Sensitivity to raw material costs is also indicated in Table 2, which compares the break-even prices of the products at raw material costs of 3000 and 5000 pesos/ton respectively. It is notable that fish cake prices are most sensitive to increases in raw material costs, the price rising by 22.5% in this case. Canned product prices are the least sensitive to varying raw material costs, prices rising by 9.3–14% for the same increase in raw material cost.

Marketing and Profitability Aspects

At raw material costs of 5–6000 pesos/ton (a pessimistic assumption), the maximum break-even prices for dried-salted fish cakes for Model I and Model II systems are 56 pesos/kg and 62 pesos/kg respectively. Taking into account a likely price from the Model I system (including probable distribution and profit mark-ups), the cost of the dried-salted fish product has been compared with the equivalent costs for alternative animal protein sources in

Table 3. Costs of various sources of animal protein in Mexico compared with cost of fish cake protein

Food Item	Price* (Pesos/kg)	Protein Content (%)	Cost per 100 g Protein (Pesos)
Egg	22.00	11.0	20.0
Cheese	108.00	19.0	56.8
Milk	8.75	3.3	26.5
Chicken	51.30	18.0	28.5
Pork (leg)	70.00	16.4	42.7
Dried-salted shark	55.00	25.0	22.0
Fish cake	44-60†	45.0	9.8-13.3

* Prices applicable in January, 1980.

† This price relates to dehydrated cakes. When reconstituted the weight increases threefold so that the "actual consumption" price would be 15-20 Pesos/kg.

Source: Street, Young and Crean (1980).

Mexico (Table 3). Costs per unit protein have been considered in this case since this information is important when promoting the product through institutional outlets. However, it should be stressed that the objective is not to sell nutrition to the consumer. This approach is now generally rejected as a means of marketing new products. Table 3 illustrates quite clearly that if fish cakes can be sold for 10–13 pesos/100g protein (or 2–3 pesos/cake—sufficient for one meal per person) they are extremely competitive with all other animal protein food sources. This price competitiveness provides a very distinct marketing advantage for the product.

A summary of break-even factory gate prices for the products manufactured by the Model II system is given in Table 4, together with current (July 1981) retail prices for equivalent food items in Mexico. From the Table it can be seen that all products are competitively priced in comparison to the equivalent item, even allowing for substantial distribution costs and profit margins. In the case of silage, at an ex-factory price of 2–3000 pesos/ton (or 17–19 pesos/kg protein), the product also appears competitive with alternative livestock feed materials available in Mexico.

Further evaluation of the market for bycatch products, in order to fix appropriate selling prices and calculate the profitability of these industrial models, is currently in progress. Market testing of the products has already demonstrated the existence of a potential demand (De Villa y Asociados, 1980; ITESM, 1980). There is generally a considerable need in Mexico for further supplies of nutritious foods and the government has developed ex-

Table 4. Comparative prices of end products from Model II and equivalent products on the market

Product	Project Price* (Pesos)	Retail Price of Equivalent† (Pesos)
Fish Cakes	5.10 - 6.30	8.00 - 29.64§
Frozen Fish Sticks	2.20 - 2.61	6.5
Canned Picadillo	2.48 - 2.82	7.88¶
Canned Sausages	3.34 - 3.64	7.78 - 21.74¶
Canned Paté	2.59 - 2.90	9.94 - 13.24¶
Canned Fish	-	4.38 - 6.52**

* Factory gate price per 100 g end product.

† Retail price per 100 g of equivalent end product.

§ Dried/salted fish - 8.0 Pesos/100 g; dried meat ("machaca") up to 29.64 Pesos/100 g.

¶ Meat product.

** Canned Mexican sardines.

Source: Young and Marter (1981).

tensive distribution systems whereby contracts can be placed with manufacturers for supplies and products promoted and retailed. In view of this, outlets for the products appear to be assured. In any case, existing data shows that the demand for dried-salted and frozen fishery products in Mexico is increasing at a steady rate. The market for canned products is not so guaranteed since there is already excess capacity for the manufacture of the two more popular existing products—sardines and tuna. The latter product is highly priced in Mexico but the price of sardines is subsidized and represents a low cost canned fishery product to the consumer. However, the canned products developed from bycatch were designed to compete with meat products currently on sale in the Mexican market, rather than fishery products. From this point of view, the bycatch products possess a distinct price advantage (Table 4) and the market is considered somewhat wider than it may at first appear.

Further investigation of the potential market for silage has indicated that sale of the material for pig and poultry feeding should present little problem. There is a substantial deficit of locally-produced protein feeds while pig production alone is growing at a rate of 2.1% per annum. Thus, imports of animal feeds are considerable. In the Guaymas region, the efficacy of incorporating silage in pig and poultry feeds has been demonstrated by the results of feeding trials carried out in conjunction with local farms. This has stimulated much interest on the part of the animal producers.

Another aspect of profitability is the impact that shrimp bycatch utilization would make on the shrimping industry. In order to ensure regular supplies of

bycatch, it is important that prices paid for the raw material provide a financial incentive to the fishermen and fishing cooperatives. It has been demonstrated that the raw material prices assumed in our financial analyses could contribute an attractive revenue to the Guaymas shrimping industry, the profitability of which currently appears to be declining (Young, 1980).

Project Implementation

The Mexican Fisheries Development Bank (BANPESCA) has expressed interest in the Model I industrial design and has undertaken an independent evaluation of the project. On the basis of this assessment, BANPESCA has now approved the promotion of the venture to potential investors. The Bank is prepared to act as a coinvestor with up to 40% equity and-or to provide loan capital to private sector investors on up to 90% of the project costs at a subsidized cost of capital of 15% per annum.

The Model II system was designed as a result of proposals made by the Dirección de Fomento Pesquero of the State Government of Sonora. In this case, the implementing authorities consider the project to have multiple objectives which include: creation of a model plant to demonstrate alternative uses for bycatch to attract potential investors into the industry either by duplicating the whole plant or part of it; manufacture of a range of products to facilitate further market testing and to demonstrate to potential investors the marketability of the products, and operation of a self-financing plant to utilize bycatch for human food and to demonstrate the financial viability of the operation to potential investors.

The pre-investment phases of this project are now being completed so that implementation should occur before the end of 1981.

ACKNOWLEDGMENTS

The financial evaluations on which the product costs provided in this paper are based were carried out by Dr. Peter Street and Mr. Alan Marter of the Marketing and Industrial Economics Section, Tropical Products Institute, London, U.K.

LITERATURE CITED

De Villa, G. y Asociados
1980. Estudio aceptación de nuevo producto de pescado. Report Mexican Fisheries Department. 46 pp.

ITESM
1980. Prueba de mercado (tipo localidad central) para tres productos elaborados a partir de la fauna de acompañamiento del camarón. ITESM Internal Report. 8 pp.

Street, P.R.; Young, R.H. and Crean, K.
1980. A technical and economic evaluation of a system to utilize the Mexican shrimp bycatch to produce a dry salted product for human consumption. Tropical Products Institute Report R895, London.

Young, R.H.
1980. An industrial model for the production of dried/salted comminuted fish from Mexican shrimp bycatch and its potential socioeconomic impact. Presented at the Round Table on Non-Traditional Fish Food for Human Consumption. Inter-American Development Bank, Washington, D.C. 27 pp.

_____ and Marter, A.D.
1981. Process design, costs and financial analysis of a pilot plant for the utilization of the shrimp bycatch in the Gulf of California. Tropical Products Institute Report R1002 (A), London.