Fish Protein Concentrate in the Caribbean — How Soon?

GEORGE K. PARMAN
Office of the War on Hunger
Agency for International Development
Washington, D.C.

Abstract

Fish protein concentrate (FPC) has potential in the Caribbean for (1) using underutilized and cheap fishery resources in one area of the region for the nutritional benefit of the whole region; (2) establishing local food industries producing acceptable adult and infant foods based on locally available carbohydrate sources supplemented with FPC and other nutrients and (3) improving the nutrition of the area.

The use of FPC will depend on the willingness to undertake the development of the local food industry. The careful market testing of locally produced starchy foods fortified with FPC is recommended to determine the form and flavor most acceptable to the consumer. Ultimately such a product could be manufactured by small, but modern, local plants serving limited geographical areas or island groups. Initial supply of FPC could be imported until sufficient volume was generated to justify production in the area.

FISH PROTEIN CONCENTRATE (FPC), a wholesome and nutritious concentrate, has a high potential application to the improvement of foods in the Caribbean area and to the area's economic development. Its value is particularly: (1) as a valuable protein supplement to improve the protein quality and quantity of indigenous diets, particularly the diets of the pre-school children and other vulnerable groups; (2) as a means of converting presently underutilized fish resources in one section of the Caribbean area into a stable form capable of being shipped throughout the area without need for refrigeration or special handling and (3) as a basis for establishing a food industry complex in the area, using locally available products as raw materials in the production of nutritious and acceptable foods.

The problems facing implementation of its use are discussed and approaches suggested for beginning its use.

Let's first look at FPC to see what it is, how it is made, learn something of its economics, and what its strength and weaknesses are.

FPC is essentially a fat free, stable, deodorized powdered form of dry fish. It is made by removing water, fat and other unwanted constituents from ground whole fish by suitable solvents such as alcohol, or ethylene dichloride and alcohol. In appearance, FPC is a greyish white powder with a slight, but non-fishy, odor and taste. It contains 78% or more of good quality protein and about 15% to 18% minerals, including a good balance of calcium and phosphorous. The rest is largely bound water.

FPC is, potentially, the cheapest form of animal protein; potentially, because its cost depends on certain factors. First, it takes 6 pounds of fish to make

1 pound of FPC, so the cost of fish is critical. Secondly, like any protein concentrate, it is made by a process involving special and relatively expensive equipment. Immediately you encounter the economics of plant scale. In order to produce a protein concentrate cheaply, there must be some minimum plant production level or your costs sky-rocket. In the case of FPC we estimate that it can be sold in the range of US $0.25 per pound if it can be made from fish costing no more than US $40 per ton, in a plant producing 3,000 tons of product in a 200 working day year. If one or more of these conditions aren't met, costs will go up. This, I emphasize, is true of any process.

At $0.25 per pound, on a 100% protein basis, FPC is about one half the cost of dry skim milk, up to now the cheapest source. FPC is the equivalent of milk in its nutritive value. This statement is based on:

ANIMAL TESTING. The protein efficiency ratio (PER) of FPC is at least equal to that of casein, sometimes even a little better.

HUMAN TESTING. Monckeberg, in Chile, among others, has fed FPC to infants and children in various ways and has demonstrated its equivalency to milk in supporting completely normal growth. As little as 2.5 grams per Kg of body weight of FPC as the only source of protein in the diet supported normal growth in infants. Graham in Peru has shown similar results.

The one place where milk is the superior product to any other protein source is in children acutely ill of Kwashiorkor or marasmus. In this instance, cure cannot be started with anything else but milk. Once the child has begun to regain growth, other proteins can be used. The reason is probably that milk is more readily absorbed than the more complicated proteins of meat and vegetable sources which require enzymatic systems that may be completely inoperative in the acutely ill child.

A word, too, about the safety and wholesomeness of FPC, since that was a strong and somewhat emotional issue in the development of FPC in the USA. First, the solvents used are known to dissolve many possibly harmful substances that may exist in fish; secondly, some very sophisticated testing was undertaken, under the direction of a committee of experts from the U.S. National Academy of Sciences, to determine if any toxicity problem existed. There was no evidence at all of any toxicity. Extensive feeding tests carried out in Peru and Chile have failed to show any trace of evidence of human toxic reactions from eating FPC made from edible fish. The product, as made by two approved processes, has Food and Drug Administration approval.

FPC is intended to be used as a food additive, not as a food *per se,* although in certain cases it might be used in the home as an additive to home prepared foods. Normally, however, its main, and important role, would be as a protein supplement in foods like bread, flour, noodles, infant cereals and similar products. The purpose of the addition would be, of course, to enhance the nutritive value by improving the quality and quantity of the protein. The amount needed is not great. Usually 5% FPC makes a significant improvement. Recent data from Hegsted show that a 5% addition of FPC increases the utilizable protein of flour from 3.2% to 7.0%. The addition at these levels causes, at most, only slight changes in the organoleptic quality of the food. Thus, foods can be enhanced in their nutritive value without causing taste or texture changes that might meet consumer resistance.

With this background, what is the application of FPC to the nutrition and food problems of the Caribbean area? There are, I suggest, several reasons

for giving serious consideration to the use of FPC. First, it is a cheap and nutritious source of protein which, by its nature, is capable of up-grading the protein quality of many staple foods, so it can be used as a protein fortification material in foods, as the protein source in formulated infant foods and as an additive in a variety of new foods that might find acceptance, from yam flakes to beverages.

Another important point about FPC is that it is a means of converting presently underutilized fish resources in one section of the Caribbean area into a stable form which can be shipped throughout the area without need for special refrigeration or special handling. If, for example, the presence of large stocks of sardines, or anchovies is confirmed in the southern part of the area, FPC becomes an economic way to utilize these stocks for the benefit of the whole area in a form that is far more flexible than drying or canning them. The utilization would also result in the creation of an industrial enterprise providing markets and jobs.

The use of FPC could lead to the establishment of a food industry complex throughout the Caribbean area. For example, a food product with appeal and nutritive value can be made by cooking a mixture of ground yams, FPC, seasonings and vitamins, then drying the product into powder or flake form. The plant to do this is not complicated and is relatively inexpensive. A small plant could be located on each island of the Windwards, for example, to utilize the yams grown there in the preparation of the product. The FPC would be imported, but the basic ingredient would be home grown. Again, the creation of an industry is an important by-product of a nutritutional enhancement. Besides yams, bananas, plantain and other starchy foods could be used. Similarly, an extrusion process can be used in place of the cooking and drying process. There are a variety of food forms that could be made, ranging from a readily re-constitutable powdered product for infant feeding to crunchy snack-like items.

How soon can this be accomplished? Quite soon, if there is the drive to do it. FPC, in adequate quantity, will be available by mid-1969 from approved U.S. sources, and probably also from approved Canadian sources, shortly after. There are facilities for food formulation, both in a laboratory and pilot plant scale in the Caribbean region which could provide the product in sufficient quantity for market testing. The other infrastructure—distribution and marketing—are present to an adequate degree. Only the actual food plant structure is missing and the capital requirement here is not excessive.

How can this be implemented? I suggest that two approaches be used, one through the development of foods for a government supported child feeding scheme, and two, the development of a commercial market. First, I suggest that someone with marketing experience in foods and a food technologist with food formulation experience decide upon a half-dozen, or so, products, based on FPC and locally available food stuffs, that would appear to have both consumer appeal and be suitable for feeding children. The nutritionists should suggest whatever improvements are needed for maximum nutritive value consistent with costs. The products should then be prepared in quantity at some pilot plant facilities and tried out in market and acceptability tests. These tests will be most important since they will determine whether there is a sufficient market to justify a plant or sufficient acceptability to justify use in child feeding schemes. The best approach is to limit the initial market tests to one

or two areas, develop these areas to the point where a plant can be justified, then expand from that base to other markets. During, and after, the market tests, the economist and business man must be added to the team. Also, during the tests, the products need to be modified as the market acceptance indicates.

The FPC for the foods could be imported, at least until a sufficient volume is generated to justify a plant. The volume could be increased by considering fortification of flour and bread with FPC, or the fortification of any other staple which is processed in a central plant.

When the local production of FPC is undertaken, it is important to make sure that all the elements of the system are present. There must be the resource, capable of supplying at least 20,000 tons a year, the fishing fleet that can harvest this resource, docks that can land the catch, and then, the FPC plant.

In my view, the processing techniques must be simple. I should experiment with roller dried and extruded formulations. These are pre-cooked, simplifying further preparation and insuring good sanitation and better keeping qualities. Spices and flavors can be added easily. The plant equipment costs are minimal. I should package in plastic bags. I should put a plant in virtually every large island where a market has been shown to exist.

FPC has application in this area. It can help in the establishment of a food industry, it can make a significant improvement in nutrition and it can enable locally available resources to be more effectively utilized.