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A Food Technologist Looks at Fish Protein Concentrate

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Fish Protein Concentrate (FPC) seems to cover a rather broad spectrum of products and processes when viewed by the average research worker in the field. On the other hand, the U.S. Food & Drug Administration has written extremely tight specifications for the product as they see it.

As originally written, the only allowable raw material was red hake which was extracted to remove water and oils with isopropyl alcohol (IPA). The residual solvent was not to exceed 250 parts per million (ppm). The fluoride (F) content must be below 100 ppm F, which means that some bone has to be removed. Finally, the end product is highly restricted in sales, packaging and use. It may be sold directly to the consumer only in one pound packages. There is no provision to permit its use as an ingredient in foods, even if it were so declared.

The first relaxation of this specification permitted the use of ethylene chloride, provided this was following with an isopropyl alcohol wash. The latest revision of the regulations issued August 4, 1970, permits the use of herring and menhaden as sources of raw material.

One of the great appeals for FPC was to make use of the fish species that are not normally harvested for food purposes. It would then be possible to improve the utilization of marine resources in any given area. As long as there was a restriction of red hake only as a raw material there was no organized element of the fishing industry which could get behind the project and give it the needed support.

This new regulation corrects two problems at the same time. A much greater supply of fish as raw material is made available and organized industry is brought into the picture.

Further widening of the scope of raw materials seems to be in order. For example, the anchovy needs to be included. However, the real break-through that will give a truly low cost raw material are the "trash" fishes that are taken by the shrimpers and others or can be caught during off-season.

Canada has liberalized their outlook some time earlier this year.

What is most needed now is a relaxation of the restriction of end use. This would bring in the food industry people with a real incentive to solve some of the problems rather than maintain a more or less academic interest.

TABLE 1

Percentages of essential amino acids for several proteins

Essential Amino Acids	(FAO) Reference Protein (a)	(FPC) Red Hake (b)	Soymeal (a)	Yeast (a)	Algae (a)
Lysine	4.2	8.3	6.5	7.0	2.7
Threonine	2.8	4.2	4.0	3.9	2.2
Methionine	2.2	3.2	1.4	1.2	.8
Cystine	2.0	.9	1.4	-	.2
Valine	4.2	4.9	5.0	4.0	2.7
Isoleucine	4.2	4.3	5.4	3.6	1.8
Leucine	4.8	7.5	7.7	5.9	3.6
Phenylalanine	2.8	4.5	5.1	3.7	2.0
Tryptophan	1.4	1.0	1.5	0.5	1.0

(a) Dabbah, R., Food Technology 24, 659, June 1970
(b) Sidwell, V. D., et al, ibid 24, 867, August 1970

As can be seen from Table 1 FPC is an excellent protein when compared to FAO's reference protein. It is one of the best sources of lysine and methionine which are the amino acids most likely to be deficient or low in most vegetable proteins. Included in Table 1 are similar analyses of what may be the principal competitors of FPC.

Clearly its advantage as a nutritional supplement stands out. However, many problems exist making it difficult to bring the product to the needy countries. The villages where the fish protein is most needed are far from the sea and little or no transportation exists. The coastal villages with a fish economy seldom need additional protein for their diet.

Most of the material which has been made and demonstrated so far is a long way from being the "bland and odorless" product which can be incorporated into food products at almost any level. It just plain doesn't taste good. In most areas there is a national pride which says that no one is so poor that he has to eat "poor man's" food. It must therefore be in a form acceptable to the potential user. If we are dealing with a "give away" program then it has to be a food that North Americans eat, not something we ship off to other lands.

The food must also be a familiar form as the nutritionists and food technologists are now finding out after a number of abject failures in foreign lands. It is not enough that a food is good for someone, he must like it and consume it.

When one tries to incorporate present day FPC into products he finds it is almost wholly inert. One might as well be dealing with sand as far as any functionality is concerned. By virtue of the treatment in the process the protein is almost entirely denatured. The heat and the alcohol have so altered the protein structure that one is faced with the problem of trying to "unfry" an egg.

This has not damaged its nutritional value in any way. It has simply taken away the properties that the food technologist needs to build new foods.

In brief these are: FPC does not go into solution or dispersion, FPC does not swell and bind significant amounts of water, FPC no longer has the ability to coagulate when heat is applied, FPC has no capacity for forming gels, FPC will not or cannot interact with other materials to regain some functionality, FPC has little capacity to emulsify oils and bind them in systems and FPC has no or at best little ability to form foams.

With a series of indictments such as this, it is a wonder that even the product concept is still with us. The National Center for Protein Concentrate at College Park, Maryland, stands as a monument to those persistent people who just wouldn't give up. Time will tell us whether FPC was only the enchantment of the sea and the technical challenge of developing a product and process with such great promise. It most probably will come to pass that the work is timely and will go on to a brilliant future. In any event, dedicated persons are needed to move such a massive program to completion.

Things are beginning to happen. Astra in Sweden has developed a process which can be used on shipboard which by chopping and washing the fish removes the aesthetic stigma of filth contamination. Since very fresh fish are used, this product should have a very low level of fishy odor when first made. We will have to see what happens in storage. Until and unless the basic process is changed, it is unlikely that much functionality will be left in the product. This development may tend to stiffen the position of FDA with respect to filth. It is only fair to point out that this product has to be an expensive one based on yield alone.

The more liberal outlook by the U.S. FDA should bring a great deal more support for the product from the fishing industry. Further liberalization of the allowable species to include anchovies will add another segment of the fishing industry.

What is needed most is to permit FPC as a food ingredient in order to enlist the support of the food processors and their research and product development skills.

John Spinelli at the Seattle Laboratory of the Bureau of Commercial Fisheries is working at making functional proteins by mild conditions of protein precipitation. He has been able to demonstrate benchtop samples of great interest.

Cost, as happens so often, has not met the expectations of the early workers and it is doubtful if it can. Time and process studies are on the side of reducing costs, but it looks as if the $0.40 to 0.50 per pound is a much more realistic figure than the $0.10 originally forecast. This higher price is probably quite tolerable for product development in the U.S., but tends to move the potentially good, nutritionally sound products further from the reach of the hungry.

In summary then: Fish Protein Concentrate is an excellent nutritional supplement which is today out of the reach of the people who most need it because of high cost, lack of distribution and lack of satisfactory products incorporating it.

FPC is not entirely acceptable to the U.S. FDA regulatory body because of filth adulteration and fluoride content.

FPC is not acceptable to the product development scientists, since it has no functional properties that can help to incorporate it into products, and is excluded as an ingredient by regulation.

FPC is not acceptable to the consumer because of the high frequency of bad flavor and sometimes degradation of texture and color.

FPC has a great potential in spite of all these adverse comments, if new processes and therefore products are developed which meet the needs and requirements of all interested parties.