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9. ABSTRACT

At a time when the prices of fish are rising and protein malnutrition is prevailing in many developing countries, fishermen around the world are throwing back millions of tons of protein-rich fish to die. These fish are thrown back because they are considered "trash" or "discards" or are unfamiliar species of no economical value. In the United States fishermen throw back up to 70% of the fish trapped in the nets while fishing for other market species such as flounder and shrimp. Man cannot afford any more to ignore the protein-rich marine species. Markets for under-utilized species have to be created and expanded as alternative resources to the declining supply of commercially established species, thereby augmenting the industry, encouraging resource conservation and revitalizing the familiar and long-exploited species. Conventional and non-conventional ways can be employed to utilize these species which are considered discards. The utilization of these species can be developed along these main lines; minced fish flesh (mixed species or single species), fish pastes, and dried fish products. The production of minces from many small and medium-sized fish is made possible by the use of separators, which produce meat free of bones. The meat is washed and then frozen in blocks. A combination of fatty and non-fatty fish may yield a desirable end product acceptable to the consumer. Fish pastes, shrimp pastes, and crab pastes can be prepared by various methods. To the washed, minced flesh, salt, starch, and polyphosphates are added to produce a paste from which sausages and other products can be prepared. Other products can be made such as fish mixed with potatoes, fish in spreads, dips, and soups, or several kinds of minced fish mixed together or with other ingredients to produce exciting new flavors. Species that have not been exploited yet by man must be utilized in the future and all so-called trash species must be regarded as edible species fit for direct human consumption.

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UTILIZATION OF UNDERUTILIZED MARINE SPECIES FOR HUMAN CONSUMPTION

BY

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ABSTRACT

At a time when the prices of fish are rising and protein malnutrition is prevailing in many developing countries, fishermen around the world are throwing back millions of tons of protein-rich fish to die. These fish are thrown back because they are considered "trash" or "discards" or unfamiliar species of no economical value. In the United States fishermen throw back up to 70 percent of the fish trapped in the nets while fishing for other market species such as flounder and shrimp. Man cannot afford any more to ignore the protein-rich marine species. Markets for underutilized species have to be created and expanded as alternative resources to the declining supply of commercially established species, thereby increasing industry and encouraging resource conservation and revitalizing the familiar and long exploited species.

Conventional and non-conventional ways can be employed to utilize these species which are considered discards. The utilization of these species can be developed along these main lines: minced fish flesh (mixed species or single species), fish pastes and dried fish products. The production of minces from many small and medium-sized fish is made possible by the use of separators, which produce meat free of bones. The meat is washed and then frozen in blocks. A combination of fatty and non-fatty fish may yield a desirable end product acceptable to the consumer. Fish pastes, shrimp pastes and crab pastes can be prepared by various methods. To the washed minced flesh, salt, starch and polyphosphates are added to produce a paste from which sausages and other products can be prepared. Other products can be made such as fish mixed with potatoes, fish in spreads, dips and soups, or several kinds of minced fish mixed together or with other ingredients to produce exciting new flavors.

Species that have not been exploited yet by man must be utilized in the future and all so-called trash species must be regarded as edible species fit for direct human consumption.

I would like to start out by saying that I was very impressed by the Escuela de Ciencias Maritimas y Technologia de Alimentos, by its facilities, program, students, faculty and leadership. Mexico should be proud of that.

The topic I will now discuss with you is underutilized marine species.

Man is now aware that the world food supplies, especially protein, have to double before the year 2000. He is also aware of the fact that the population on this planet is divided into two worlds, the underfed and the well fed with a nutrition curtain separating them. Man is also aware that a major emphasis has been placed on increased production, and not enough attention has been given to efficient utilization of the products into edible foods. Losses in food between production and consumption are very significant being higher in developing nations. The world distribution pattern of food is also irregular. Underfed nations produce highly nutritious food for the well fed nations, and to go to the other extreme, the underfed nations use a large acreage to produce non-nutritious crops for export to the well fed nations.

In many parts of the world one still finds valuable fish flesh from good edible species converted to fish powder or fish meal. It is a painful experience to see this happen in countries with protein malnutrition problems. One finds that almost half of the catch of good species is converted to fish meal and exported to the already well fed countries to feed their chickens, dogs and cats.

Foreign currency entering the country which exports the fish, unfortunately, does not bring back protein, so malnutrition persists although rich protein resources are present in the back yard.

Fish as food has been increasing at a rate of 7% annually, doubling every ten years, and has recently exceeded the 60 million tons annually. As far as the potential catch is concerned various estimate have been made.

An optimistic theoretical figure would be ten times the catch obtained now, assuming that only 10% of the productivity of oceans is now being exploited. To reach this theoretical goal many factors must be taken into consideration and many conditions established. One of them is the exploitation of unutilized marine resources, specifically unutilized marine species.

At a time when prices of fish are rising and protein malnutrition and hunger is prevailing in many developing countries, fishermen around the world are throwing back millions of tons of protein-rich fish to die. This, is a nutritional crime. These fish are thrown back because they are considered trash-fish, and they happen to belong to the unfamiliar, non-commercial fish category. Traditionally these species have been considered to be inedible. In the United States fishermen may throw back as much as 70% of the fish caught while fishing for other market species such as shrimp and flounder. About ten species make up 80% of the commercial catch, and some of these, such as menhaden are used for industrial purpose and not for direct human consumption. The intense fishing pressure on those species produces the already known phenomenon of declining fish stocks due to over-fishing.

Some of the commercially known species that are being over-fished today were not acceptable in the past. An example is haddock which was discarded from catches as being of no value. Another example is the whiting, which only a few years ago was utilized as animal feed, whereas, now it is being utilized in preparing human food products.

It would be a very difficult task to list the untapped fisheries of the world. In the North Atlantic region squid is considered to be an underutilized species. It is estimat ed that the average annual catch can increase by ten times if the need and demand for squid increases. On the other hand, other countries such as Japan have solved the protein problem by capturing anything

that swims or crawls in the oceans of the world.

Fish has been shown to be highly nutritious. It is rich in proteins with an excellent amino acid ratio and of high biological value. I have two illustrations here showing the value of fish protein as related to growth and recovery from malnutrition.

Since it is impossible to discuss all under used species I will now briefly mention three underutilized species hopefully representing three different categories of aquatic animals. The squid, the shark and the krill. All three are considered underutilized for most regions of the world.

The edible portion of squid is about 80% of the total weight. In fish the edible portion is about 40% to 70%. The fat content is low about 1-1.5%. The protein is of high biolgoical value. In spite of all these advantages squid is only utilized to a great extent by few countries of the world.

The shark is a particularly popular item in Japan and many other countries, but not so much in the U.S. The presence of urea in its tissues 1-2% gives it a characteristic flavor. Urea can be removed by soaking the flesh in water, processing or cooking it.

Krill is a Euphausid. It is a crustacean similar to a small shrimp. It is about 2 cm long and has a total weight of about 1 gram. The edible portion is about a quarter of that. The composition of its body is of excellent nutritional value. The Krill is already being utilized by the Russians and Japanese who prepare a flavorful paste from Krill. The Krill is first washed pressed and a juice is extracted. The protein of the extract is coagulated by heat and collected. The composition of its body is, fat from 1-6%, protein 11-15% and moisture 72-80%. Due to its strong and acceptable flavor it can be used in food products where such a "shrimp-like" flavor is desired.

Conventional methods of processing could be applied to the underutilized species. To produce traditional foods the technological characteristics of the species will have to be studied and the method of processing to be used may have to be adapted for a particular species. Another approach which I will dwell on is to use non-conventional processes. Such processes change the identity of the raw material, and the product may become acceptable and attractive to the consumer.

In Japan, a large part of the total catch is utilized for the production of non-conventional marine food items such as fish sauces, fish gels, fish sausages and ham. In all these products the identity of the raw material is lost. By using the principles and the technology involved in the preparation of some of the traditional Japanese products, new products can be produced which may become acceptable to different people, who traditionally have not eaten fish because its flavor was not acceptable.

A marine food product that would serve the purpose of not only developed countries, but also developing nations is fish pastes similar to the Japanese gels, modified to suit the western or other consumer demands. Fish paste, prepared in the specific manner described below, has no fish flavor or odor and can be prepared with spices or flavoring. This flavored, funtional product may then be used to improve protein-deficient diets or used to add variety to diets.

The simple laboratory process of preparing a fish paste involves the following steps:

The flesh is separated from skin and bones. This can be done using a deboning machine or it can be done by hand. The flesh is then passed through a meat grinder and washed in chilled water several times to remove blood, fat, small particles, mucous and odor compounds. The treatment improves color, odor, flavor and enhances elasticity in the product.

Washed fish flesh is dewatered by centrifugal dehydration or by using a hydraulic press. The moisture content is adjusted to about 82% and a fish pulp is produced.

The fish pulp is then ground in a meat chopper and mixed as the following ingredients are added:

2,5% NaCl, 0.2% sodium tripolyphosphate, 10% starch, and flavoring compounds such as spices, monosodium glutamate etc.

After this step the product is a white sticky gel. The myofibrillar proteins have interacted to form a gel structure with a good water-holding capacity.

Next, the gelled product is shaped or cased in special pouches and heat treated.

A number of heat treatments may be used, but one method is to immerse the cased gel in hot water (85°C) for one hour. This pasteurization process will impart elasticity to the paste by forming a porous elastic network structure. In addition, the microbial load is lowered significantly. Immediately after pasteurization, the cooling step is introduced. The final fish paste can now be refrigerated and has a shelf life of about two weeks, or it can be left at room temperature, which reduces shelf life to about two days.

Fish pastes can be tailored to meet consumer preferences for flavor, color and texture. The process for preparation is simple and inexpensive. Flesh separator machines facilitate the method to a great extent, but fish paste may also be prepared at home. Fish flesh from various underutilized species may be used to obtain a homogenous fish paste, thus contributing to efficient utilization of the marine resources for human consumption. Waste products such as trimmings from the fish filleting process may be utilized for fish paste. With the fish flavor removed, fish paste has the advantage over other fishery products in that it can be incorporated into the dietary patterns of tradition-

ally non-fish eating populations.

I would like now to go to another rich marine protein resource that is not utilized very much and this is the crab. Crabs are present in all the seas of the world. They may vary in size but they have one characteristic in common and that is that their body consists of edible and nutritious ingredients.

In many parts of the world crabs are considered to belong to the unutilized species. In many parts of the world again crabs are ignored, they are classified as undesired, unfamilar species of no commercial value. If caught incidentally they are thrown back to the sea.

In many cases the size of the animal limits the exploitation of this resource. However, in countries such as Japan, crabs as small as two centimeters in diameter are being utilized in various dishes. So it is the general structural characteristics of the crab that have been the reason for the improper and inadequate utilization of this species for direct human consumption for many centuries.

Handpicking and machine picking procedures are good only for large sized crabs and for crabs that have a high proportion of edible portion to shell.

In order to totally utilize crabs of any size a laboratory method was developed by which the extractable components of the crab can be obtained by using hydraulic pressure.

The process involves subjecting the whole crabs or segments of the crab such as claws, carapace and so on, to hydraulic pressure up to 5000 lbs per square inch, between two plates. This operation is also suitable for extracting what is left in the crab body following the handpicking or machine picking operation for meat extraction.

Commercial straining machines such as the Beehive, Bibun and others, can be adapted and used for the same purpose. The pressed out liquid is collected and is further processed into a powder by drying. The pressed out shell cake is also dried and then ground up into small pieces. Meat picking yields on the average 21% of the crab body and leaves behind 67% of the crab in form of shell waste, and about 12% losses. If the shell waste is further processed using the pressing method, an additional 20% of rich crab body portion can be extracted leaving behind as final shell waste about 47% of the original crab. In this case the total yield that can be utilized is about 40% of the crab body; 21% from the meat picking operation and 20% from further extracting the edible portion from the shell waste. As mentioned before both the extracted portion and the shell waste can be dried producing a crab powder and dried shells respectively. The yield in crab powder is 10%. The crab powder obtained is a functional product, rich in nutrients and extremely flavorful.

This process can utilize more of the crab body, doubling the yield of the edible portion of the crab.

The entire crab waste is utilized, minimizing pollution problems.

This process can be extended to other crabs and in general crustaceans Waste from the shrimp, lobster, crayfish industries could be utilized in the same manner. It can be used for fortification of low protein foods such as in potato,soups, onion soups, tomato soups, dips, extruded corn or wheat products. If offers the advantage of imparting crab flavor to foods such as thos mentiond.

The extracted crab powder can be used in aquaculture, as a source of good protein, partly replacing the other proteins present in the commercial diet.

Finally crab and other curstacean waste remaining after handpicking can be and therefore should be utilized both for food and feed making important nutrients available to man in a direct manner or indirectly through food.

Another approach to use for the underutilized species would be to use the technology developed for frozen fish blocks. Under-exploited species can be mixed in a manner similar to the frozen blocks obtained using the commercial species caught.

The fish are headed and degutted, then passed through a meat separator machine which separates flesh from skin and bones. The minced product obtained is washed in cold water using three parts water to one part flesh. Water is then adjusted to about 5% above the original water content of the flesh. The fish flesh is then frozen into blocks at a temperature of -30°C for 4 hours.

Machine separation of edible flesh from fish offers a great potential for the utilization of species that have been ignored. By mixing a few species an indefinite number of products containing various concentrations of each species can be produced. Mixing lean fish with fatty fish optimum conditions can be found that would produce an acceptable food item.

Another method developed in Mexico by Professor Fancisco del Valle has proven to be of great importance in utilizing fish flesh in a non-conventional way. This is the quick salting process, which utilizes ground up fish flesh mixed with salt, pressed and dried. The salted product has a long storage life at ambient temperatures. The product is desalted before use by leaching out the salt in boiling water. This proces is of great significance for it can contribute to a better utilization of the lesser known species. Species can be mixed and one uniform product obtained. It could also be applied to fish plant waste such as trimmings, and other waste.

Processing techniques and new methods of utilization are not sufficient to make the underutilized species acceptable to the consumer. Man eats meals, therefore, appropriate recipes have to be developed in order to make the unfamiliar species acceptable as a meal.

To conclude, I would like to stree the point that man can no longer ignore the valuable marine resources, of his oceans, which he has not been utilizing. What is now considered to be trash fish or inedible fish will very soon become useful and edible fish. The technology is available.

Utilization of the unexploited species will encourage resource conservation and will revitalize the familiar and long exploited species. The use of a variety of species which are abundant during different seasons would produce year round catches and year round employment.

Fortunately, the marine food resources are renewable resources. If properly managed, harvested and utilized by obeying the rules of ecology and conservation these resources will continue to supply the invaluable animal source protein that man on this planet needs so much.

Thank you.