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Past, Present, and Future Uses of Minced Fish

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Today, the state of evolution of minced fish utilization in the United States might be described as "the end of the beginning." Products made from minced fish have entered U.S. markets. Most of this production is based on imported minced fish blocks. Some, but not all, of the problems in introducing these new products can be traced to quality characteristics of these imports. Problem areas include variability between different sources of raw material, inconsistent quality from a given source of raw material, and deterioration of quality during frozen storage.

In the United States, present uses of minced fish include fish sticks, fish portions, salted fish, seafood patties, and other products made by extrusion. Most of our commercial use of minced fish blocks is for fish sticks. Fish portions are consumed, but there is a limited supply of truly white minced fish blocks for this application. A New England firm is test marketing salt fish produced from minced fish obtained from fish frames (backbones). Seafood patties and other extruded products have been produced or are being test marketed.

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Anticipated directions of future research and development cover the entire spectrum from harvest through processing, storage, marketing, and new product development. Several of these activities will occur overseas and will impact on U.S. consumption of minced fish products. Some thoughts about directions of these activities include the following: 1) Improve frozen storage stability of minced fish blocks and breaded products made from these blocks; 2) modify the texture or "mouth-feel" of minced fish products so that it is more akin to that of fillet products; and 3) in contrast, concentrate on development of new products based on the natural characteristics of minced fish, for example, mixtures with ground beef. In addition to needs for future research and development, international cooperation is essential to development of realistic product names and quality assurance documents for minced fish products consumed in the United States.

THE PAST

A relatively small quantity of minced fish blocks has been imported since, at least, the early 1960's. Most of these earlier blocks were made in Iceland or Canada using v-cuts (fillet trimmings containing rib bones). In the United States, some of these blocks have been used to make fish sticks from the early 1960's to now. Other blocks, having a less white appearance or a less fibrous texture, have been used to make fish cakes and other products.

The amount of imported minced fish blocks increased dramatically in the 1970's. In 1972-73, U.S. importers of fish blocks started feeling the pinch of short supplies and higher prices for the fillet blocks that had been used for making fish sticks and portions. They turned to minced fish blocks and to Alaska pollock fillet blocks to meet part of our consumer desires for sticks and portions. Consumer reactions in this initial period were mixed. By early 1974, our freezer warehouses were full of both fillet and minced fish blocks. The oil crisis of 1974-75 did not help matters since it kept block prices high and movement of these blocks was slow. During this period, the U.S. industry became painfully aware that minced fish blocks lost quality at a faster rate than fillet blocks during frozen storage. More and more consumers complained about poor quality of fish sticks made from minced fish. For example, complaints about rubbery texture could be traced often to the use of minced Alaska pollock blocks. Quantities of fish blocks in freezer warehouses finally returned to normal by mid-1975, and an "older but wiser" attitude is now prevalent.

Laminated blocks entered into U.S. production of fish sticks and portions recently. They are mixtures of fillets and minced fish in which the minced fish originates from fillet trimmings (such as v-cuts), and it is spread uniformly on fillet surfaces. The amount of minced fish may represent its

natural proportion in the headed and gutted fish. If laminated blocks contain too much minced fish, they are apt to fall apart or shatter during sawing. Laminated blocks, containing up to 10 percent (United Kingdom) or 12-14 percent (Norway) evenly distributed minced fish, have gained acceptance by U.S. producers of sticks and portions. Lamination represents a greater use of fish as food. Some earlier imports of "sandwich" blocks were rejected because they contained much more minced fish, and it was usually concentrated in the center of the block.

There have been attempts to produce minced fish blocks in the United States. They have been economically unsuccessful. Problems include how to gather enough raw material at one place to justify investment costs and how to develop suitable machines for processing a variety of materials. While supplies of imported minced blocks continue to meet U.S. needs, there is little incentive to produce domestic blocks. However, at least one U.S. firm is taking advantage of a local supply of fish frames (backbones) from filleting lines to make salted fish by a quick salting process based on minced fish.

THE PRESENT

Among U.S. users of minced fish blocks for making fish sticks or portions, appearance (color), texture, excessive thaw drip, blemishes, and consistency of quality are the most often mentioned shortcomings. These shortcomings are related to each other. For example, minced blocks derived from cod or haddock fillet trimmings (v-cuts) have a reasonably fibrous texture, a desirably white appearance, and a minimum of blemishes because their source material is free from skin and membranes. These qualities have diverted this supply of minced blocks into making more and more portions instead of sticks during the last few years. On the other hand, other source materials such as headed and gutted fish are much more abundant. Some of these source materials yield minced blocks that have too many blemishes or are too deeply colored (off-white) for use in fish sticks. These appearance defects can be partially removed, but there is a concurrent sacrifice in textural quality. Such blocks lack the "fibrous" or uniform appearance of "v-cut" blocks, and their texture is more apt to become elastic or rubbery after frozen storage. Some of these blocks have had too much thaw drip (excessive moisture) by the time they were made into fish sticks. Although this defect can occur in fillet blocks, the sponginess of minced blocks makes it more difficult to measure, as well as control, thaw drip in order to estimate their suitability for making fish sticks.

Problems with excessive moisture and rubbery texture in fish sticks made from some minced fish blocks have led some U.S. users to mix textured vegetable protein with the minced fish. These products have had better acceptability. If textured vegetable protein were added at the time the blocks were first made instead of thawing, mixing, and then freezing the minced fish a second time, quality of these products might be improved even more.

United States users of minced fish blocks have a limited experience with products other than sticks or portions. A breaded portion-like product was made from minced croaker. Its most noteworthy feature was an attempt to mimic texture of fillets by fashioning minced flesh into scallopy layers about ¼-inch (5-mm) thick, piling them, and cutting into the pile to make the "portions." Another breaded product was based on extruding minced croaker into a shrimp-like curl. Both of these croaker-based products failed due to marketing and technological difficulties. Current efforts are directed towards making croaker surimi blocks for export to Japan.

For minced fish blocks whose appearance (off-white color or too many blemishes) is not favorable in fish sticks, some limited product applications exist in the United States. These blocks continue to be used for making fish cakes. Gefilte fish is made in the United States using minced fish blocks from Canadian freshwater species. Minced fish has also been used to make frankfurter or sausage-type products. In the past 20 years, there have been several attempts to market them. Their success has been limited due mostly to marketing problems and, sometimes, technological problems. Present consumer demand for all of these products is significantly less than the potential supply of minced fish blocks from headed and gutted species.

Some U.S. firms are using minced fish blocks to make seafood patties. These breaded products usually contain seasoning and may contain small pieces of shellfish such as shrimp or clam. They represent a present use with a growth potential for those minced fish blocks whose appearance makes them less attractive for fish sticks.

THE FUTURE

The future of imported minced fish depends on how suppliers respond to U.S. market opportunities. There is considerable disenchantment based on our previous experience, especially with minced Alaska pollock blocks. In the near future, we may expect development of new extruded products, and also mixtures of fish and other ingredients. To improve textural quality, addition of textured vegetable protein has been suggested. Other suggestions include adding seasonings to improve flavor or using other additives to extend useful storage life. Some of these suggestions have been tested on imported minced fish blocks. It is generally agreed that any of these additives should be mixed with minced fish where the blocks are made instead of reworking the blocks in the United States.

Regarding the longer range future supply of minced blocks in the United States, four suggestions are offered: 1) Improve packaging; 2) improve market names; 3) improve quality and useful storage life; and 4) develop alternate marketing directions.

With the exception of surimi blocks, most imported minced fish blocks have had the same waxboard packaging as fillet blocks. By the time they are received in the United States, most of them have dehydration on their edges, sides, and top where the waxboard carton had come loose during handling. It seems obvious that minced fish would lose moisture at a faster rate during frozen storage because it lacks the tissue structure of fillets. A simple overwrap with a plastic moisture-barrier film appears to be a feasible solution. It would help maintain integrity of the waxboard carton as well as inhibit loss of moisture. Its cost should be outweighed by an improvement in quality and storage life of the imported minced fish blocks.

In the United States, market names for species of fish have been a complicated topic except, perhaps, for those people near our coastline. This situation is becoming even more complicated as "new" species arrive at our ports. The potential supply for minced fish can compound this problem

since some species now have unattractive names or none at all save their taxonomic name. The National Marine Fisheries Service has started a "Plan for Market Names of Fishery Products." It calls for a fishery product to be identified by an appropriate group name. Each group would have a descriptive, one word name, and the total number of food groups would not exceed 30. These group names would be based on edibility characteristics instead of biological or taxonomic ones. This plan is an ambitious undertaking that requires agreement between industry, government, and consumers.

There is an ancient saying in food technology that it is harder to substitute a new ingredient in an existing product than to develop a new product which uses the natural characteristics of this new ingredient. This saying applies to minced fish blocks. For production of fish sticks and portions, the best sources of minced blocks come from fillet trimmings (v-cuts). Minced blocks derived from headed and gutted fish usually have defects of off-white appearance, blemishes, or rubbery texture for these applications. Since the potential supply of headed and gutted fish is far greater than that of fillet trimmings, there is a clear-cut need to develop alternate marketing directions for these sources of minced fish. Some U.S. research activities in this direction are outlined in the following paragraphs.

When headed and gutted fish are used to make minced fish, white or black belly membranes and blood-rich tissues can cause blemishes to the appearance of this minced fish if not removed beforehand. There is a need for more versatility, capacity, and automation in equipment which provides the material for meat-bone separators. This need has stimulated machine development for those fish which are unsuitable for filleting. Fish can now be beheaded, eviscerated, split, and washed in a single machine which provides virtually blemish-free material to a meat-bone separator. This study includes development of grading and sorting equipment as well as suitable equipment to unload a fishing vessel rapidly. Attention has also been given to storage of a "mixed bag" (those fish which are harvested but which have been unwanted) on a fishing vessel (1).

Storage studies of minced fish blocks are underway in several laboratories. These studies are based on several undervalued, headed, and gutted species obtained from Atlantic, Pacific, or Caribbean waters. The studies include processing variables such as washing the minced flesh before freezing, the use of various additives, and packaging the blocks in plastic films which have low moisture or oxygen permeability. Most of these studies have not yet reached their completion (see 1, 2, 3).

There is considerable interest in using additives with minced fish to extend its useful storage life. By now, it is generally recognized that a minced fish block is more susceptible to the effects of storage conditions than a fillet block. Changes in texture or in flavor are especially noticeable.

To inhibit textural deterioration in commercial, frozen-stored minced fish blocks, tripolyphosphate or other condensed phosphates have been used. These compounds are used successfully to preserve fillet blocks during frozen storage. In the case of minced blocks, addition of these compounds involves a more uniform distribution of phosphate throughout the mass of flesh, and the flesh itself has lost most of its original structure as a consequence of mincing. Recent research results suggest that these phosphates may cause, not inhibit, development of a tough, rubbery, undesirable texture (2). Even salt (sodium chloride) by itself may be an undesirable additive in minced fish blocks (2).

To inhibit development of rancid or bitter off-flavors in frozen-stored minced fish blocks, several antioxidants have been proposed. Among the phenolic food antioxidants (such as BHA, BHT, PG, and TBHQ), the most effective additive appears to be TBHQ (2), but there are practical difficulties in controlling the addition of any of these lipid-soluble antioxidants to minced fish muscle (1). Sodium erythorbate (a compound closely related to ascorbic acid) can inhibit development of off-flavors in frozen-stored minced fish, and it has advantages of water solubility and it is generally recognized as a safe additive (1). Related studies are demonstrating that proper packaging such as Saran-wrap[1] can inhibit oxidative rancidity and dehydration in frozen-stored minced fish (1).

The concept of mixing species is gaining acceptance in the case of minced fish products. Many of the physical characteristics which distinguish flesh of one species of fish from another disappear as a consequence of meat-bone separation. The flesh itself is more readily identified as minced than of the species from which it was derived. However, problems exist in identifying particular species which might be mixed together for food applications. Most of the recent work in chemical aspects of this problem has been from the Halifax Laboratory, Fisheries and Marine Service, Halifax, N.S., Canada. A physical aspect of this problem has been identified in the case of species which have undesirably soft texture. Arrowtooth flounder or soft Dover sole can be blended with firmer textured species (such as rockfish) so as to take advantage of the desirable flavor of flounder and, in effect, eliminate the problems associated with using these soft textured species (2).

The color of minced fish from headed and gutted species or from frames (backbone material after filleting) and its nutritional attributes suggest use as an extender for red meat products. Our published work suggests several possible applications (1). More recent work includes mixing minced Pacific hake flesh or rehydrated drum-dried hake protein with ground beef to make "beefish" patties (2). Results of cooking tests indicate that addition of rehydrated fish protein reduces moisture loss during cooking (2). The taste of unseasoned patties is not the same as an all beef pattie (1, 2). Highly acceptable seasoned beefish patties have been prepared (1, 2, 4). The concept of seasoned beefish mixtures is being developed by concentrating on cured products such as beefish frankfurters (wieners) (2). Initial results have encouraged the U.S. Department of Agriculture to develop new standards for processed meats which will provide for replacing meat with up to 30 percent fish flesh, soy protein, or poultry meat. We understand that Japan and Poland have started to develop similar product applications.

Minced fish might be sold directly to consumers in the form of one or five pound frozen blocks (1). This suggestion includes results from a market survey indicating that a small block could have commercial potential for both retail and institutional trades. From such a consumer sized package, minced fish can be used in an almost endless

[1]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

variety of consumer or institutional recipes such as sauces, salads, soups, and beefish main courses.

Minced fish from fish frames (backbones) or headed and gutted fish may be quick salted by a process which has a high throughput capacity (1). It is based on mixing minced fish with saturated brine and excess salt, then pressing and drying the salted flesh and packaging it. The product is capable of long-term room temperature storage. Its commercial potential may be increased if more uses for minced, salted fish are found.

Mixtures of shellfish meats and minced fish in breaded products appear promising for commercial applications. Some oyster meats may have a low market value due to physical defects such as size or shucking damage. Blends of diced oyster meats with minced fish have resulted in highly acceptable oyster flavored products whose taste can be modified to suit those who may object to the strong flavor of undiluted oysters (2). Small shrimp or shrimp pieces have been mixed with minced fish muscle to produce a shrimp flavored fish portion. In addition to being highly acceptable, it has been reported that the shrimp component improves storage characteristics of the minced fish component (5). Ocean quahog meats are being considered for a similar type of product since they have a robust flavor and a relatively low market value (1).

Meat-bone separators can be used to obtain minced crab meat. Most of this development work has been done by industrial organizations. It is stimulated by a desire to find an economical replacement for handpicking meat from some species or an economical supplement to handpicking for increasing yield of meat from other species. In one study, use of a meat-bone separator was discarded in favor of other equipment which provided larger, more valuable pieces of crab meat (1). If more applications can be developed for minced crab meat such as mixtures with minced fish, crab cakes (1), or seafood patties (6), this application of meat-bone separators may become more popular.

Several laboratories are working on development of new seafood products which are based on minced fish. These products include fish sausages, extruded breaded products, seafood pizza, chowders, beefish items, and products containing textured vegetable protein (1, 2, 4, 6, 7, 8, 9). Some laboratories are studying physical or nutritional properties of minced fish (6, 8, 9, 10).

INFORMATION SOURCES

The subject matter of this communication includes numerous references to unpublished work, about-to-be-published work, and publication in hard-to-find places. Instead of the usual list of references, a list of addresses is provided. If you are interested in learning more about a topic, contact the appropriate address given below.

1) Northeast Utilization Research Center, National Marine Fisheries Service, NOAA, Emerson Avenue, P.O. Box 61, Gloucester, MA 01930.
2) Pacific Utilization Research Center, National Marine Fisheries Service, NOAA, 2725 Montlake Boulevard E., Seattle, WA 98112.
3) Southeast Utilization Research Center, National Marine Fisheries Service, NOAA, Regents Drive, University of Maryland Campus, College Park, MD 20740.
4) Department of Food Science & Technology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.
5) Seafoods Laboratory, Oregon State Laboratory, 250 36th Street, Astoria, OR 97103.
6) Seafood Laboratory, Department of Food Science, North Carolina State University, Raleigh, NC 27607.
7) Institute of Food Science & Marketing, Cornell University, Ithaca, NY 14850.
8) Food Science Department, University of Georgia, Athens, GA 30602.
9) Department of Food & Nutritional Science, Univeristy of Rhode Island, Kingston RI 02881.
10) Food Protein R&D Center, Texas A&M University, College Station, TX 77843.

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