MINCED FISH: 
Its Production and Use 

By Tyre C. Lanier and Frank B. Thomas

UNC Sea Grant Publication UNC-SG-78-08
AUTHORS

Tyre C. Lanier, Assistant Professor, Department of Food Science, N.C. State University

Frank B. Thomas, Extension Seafood Specialist, Department of Food Science, N.C. State University

Line drawings by Constance Mason. Special thanks to Theodore Miller, David A. Hill and Joyce Taylor of the NCSU Seafood Lab in Morehead City, and to Barbara Barbour, C.S. Cheng and Donald D. Hamann of the NCSU Food Science Department in Raleigh.

The use of trade names in this publication does not imply endorsement of the products named, nor criticism of similar ones not mentioned.

This work was sponsored by the Office of Sea Grant, NOAA, U.S. Department of Commerce, under Grant No. 04-6-158-44054, and the North Carolina Department of Administration. The U.S. Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright that may appear hereon.

Price: $1.50
Residents of North Carolina may request a single copy free of charge. Copies are available from:

UNC Sea Grant
105 1911 Building
North Carolina State University
Raleigh, N.C. 27650
MINCED FISH: AN INTRODUCTION

Mechanically deboned minced fish, or simply minced fish, is the edible muscular flesh of fish or shellfish that has been mechanically separated from the bones and shell.

The product itself varies in consistency from that of coarsely ground hamburger to a fine paste, depending upon the type of machinery used for deboning. Ideally it is prepared from high quality fish that have been deheaded and eviscerated and should contain no foreign material such as scales, shell fragments or bone. In its final form, minced fish is a quality food product intended for human consumption as either an ingredient or extender in prepared seafood or in foods requiring further processing.

Why produce minced fish? The reasons are many. But directly or indirectly they benefit both the consumer and the producer.

Mechanical separation of flesh from bones is less costly than hand deboning. It is also more efficient. In many cases yields have been increased by 100 percent or more through mechanical separation. As a result, meat from filleting and picking wastes, which might otherwise be ground into pet food, can be used in foods for human consumption. In addition, the efficiency of mechanical separation permits the
use of certain species or size categories of fish that cannot be handled by traditional methods. Thus, less expensive raw materials can be used in minced fish.

Even the textural properties of minced tissue offer certain advantages. The small particle size of minced fish permits greater control over the quality attributes of the final product. Ingredients may be easily added or deleted to the minced tissue to enhance the color, flavor or texture of the product and to extend storage life. As a result, the product potential for minced fish becomes almost endless.

The purpose of this publication is to introduce the packer or processor of fishery or meat products to the exciting profit possibilities of minced fish and to answer many of the questions he may have regarding its production and processing into consumer foods. Each phase of minced fish processing, including selection and preparation of raw material, proper equipment, quality control, frozen storage and product applications, is covered in an introductory manner.

Individuals or organizations who are seriously considering the processing of minced fish may want to contact the Food Science Extension Office at the NCSU Seafood Laboratory in Morehead City, N.C. for more indepth information.
RAW MATERIAL AND PREPARATION

Starting with the right kinds of raw materials as well as following the proper preparation procedures are essential in the production of quality minced tissue. They affect both the texture and flavor as well as the wholesomeness of the product. Ultimately, they affect the marketability of minced fish.

Minced tissue can be prepared from any species of fresh fish or shellfish or from fresh filleting or picking scraps. (See Figure 1). It is essential, however, that only fresh, clean materials be used in the manufacture of minced fish, as mincing will spread any surface bacteria or filth that may be present throughout the entire tissue mass.

![Diagram of mincing process]

Figure 1. Production of minced fish.
In finfish, the head as well as the scales and viscera should be removed. Special care should be taken to completely remove the black stomach lining found in many species as well as the air sac and residual kidney tissue. The presence of these tissues in the minced muscle tissue can result in dark spots in the product, detracting from its overall appearance.

Large fish may require size reduction before mincing, depending upon the capacity of the equipment being used for tissue separation. In many cases it may also be necessary to remove the backbone above the belly cavity to allow for proper processing. This not only removes any residual kidney tissue, but minimizes the amount of kidney blood that mixes with the minced flesh and gives the product a lighter color. In general, the use of whole fish also results in the production of lighter-colored minced flesh, since the ratio of white meat to blood is much higher.

Immediately before mincing, the fish should be thoroughly washed to remove any trace of slime or scales. Thorough chilling prior to deboning is also necessary to prevent excessive build-up of product temperature during mechanical separation.

EQUIPMENT AND OPERATION

A variety of machines are available for mechanically separating fish flesh from the bone or shell. Table 1 lists the machines most commonly used today. These machines basically fall into one of two categories based on the system of separation.
<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>MODE OF SEPARATION</th>
<th>TEXTURE OF MINCED PRODUCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nordischer Maschinenbau</td>
<td>Tension belt and perforated drum</td>
<td>Coarse to fine</td>
</tr>
<tr>
<td>Rud Baader</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lubeck, Germany</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beehive Machinery Co.</td>
<td>Auger/cylinder with screened head</td>
<td>Very fine</td>
</tr>
<tr>
<td>Sandy, Utah</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bibun Machine Co., Ltd.</td>
<td>Tension belt and perforated drum</td>
<td>Coarse to fine</td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iwema Food Machinery Co.</td>
<td>Rotating lathes and perforated stationary</td>
<td>Coarse to fine</td>
</tr>
<tr>
<td>Goteberg, Sweden</td>
<td>drum</td>
<td></td>
</tr>
<tr>
<td>Kartridg Pak Co.</td>
<td>Piston/Cylinder with concentric ringed</td>
<td>Very fine</td>
</tr>
<tr>
<td>Davenport, Iowa</td>
<td>head</td>
<td></td>
</tr>
<tr>
<td>Stephen Paoli Manufacturing Corp.</td>
<td>Pressure plate and grooved, perforated</td>
<td>Coarse to fine</td>
</tr>
<tr>
<td>Rockford, Ill.</td>
<td>drum</td>
<td></td>
</tr>
<tr>
<td>Prince World Co., Ltd.</td>
<td>Auger/Cylinder with screened head</td>
<td>Fine</td>
</tr>
<tr>
<td>Gainesville, Ga.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seffelaar and Looyesn, Inc.</td>
<td>Piston/Cylinder with concentric ring head</td>
<td>Very fine</td>
</tr>
<tr>
<td>Holland, Michigan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yanagyia Machinery Works, Ltd.</td>
<td>Tension belt and perforated drum</td>
<td>Coarse to fine</td>
</tr>
<tr>
<td>Yamaquchi Reef, Japan</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Machines most commonly used today.
The first type (Fig. 2 & 5) may require the grinding of the fish in a separate machine before feeding into the separator. The fish is then fed into a cylinder where pressure is applied, either by an auger or a piston, to force the meat through small openings, leaving the bone residue behind. The bone is discarded through a separate channel and the finely divided fish flesh is immediately chilled, packaged, and stored.

Many of these auger or piston-type machines have cooling devices attached to the separator head to reduce temperature increases during processing. Separation efficiency and temperature change are controlled primarily by adjusting the head pressure. Increasing the head pressure results in greater yields but may also increase the bone and calcium content of the meat while generating more heat in the product. These machines finely comminute the meat, leaving no discernable bone particles in the flesh. Grinding prior to separation can, however, introduce more bone calcium into the final product. Thus, operation of the machines must be controlled closely to insure that federal standards for calcium content are met.

The finely ground fish paste produced by this process is an excellent raw material for gel-type products requiring further processing, such as hot dogs, luncheon meats and the like, but it is less suitable for use as a primary ingredient in products where a flaky texture is desired, such as in fish sticks. This material can, however, be very effectively used as a binder or extender in flaky-textured products.

The second class of machines produces a product more closely resembling hamburger in texture. In these, the intact fish are pressed against a drum perforated with holes or grooves by means of a pressure plate or high tension belt (Fig. 3 & 4). The meat is squeezed through the drum openings into the interior of the drum, while the bones remain on the outer drum surface and are removed with a blade scraper. Efficiency of separation can be controlled by adjusting the tension belt or pressure plate or by selecting a drum having holes of the correct diameter. The manufacturers of deboning equipment can recommend the correct drum for each product being processed. These machines may be cooled by the injection of carbon dioxide or a similar coolant into the drum interior to reduce product temperature increases.
Figure 2. Basic operation of the auger-type machine.

Whole or Ground Fish

Feed Screw

Auger

Feed Pipe

Perforated Head

Auger

Minced Flesh

Waste
Figure 3. Basic operation of the drum-type machine.
Figure 4. A drum-type machine (photo courtesy of Nassau Nova Scotia Corp.)

Figure 5. An auger-type machine (photo courtesy of Beehive Machinery, Inc.)
Several factors should be considered when selecting equipment for mechanical flesh separation. The most important consideration is how the products are going to be used. For example, some products require a fibrous textural characteristic. This is more easily obtained through the use of a drum-type machine. Coupled with a straining apparatus, the drum machine can also produce a fish paste. Straining removes large bone particles that may pass through the holes of the separating screen and enter the product. It also removes small pieces of skin and other particles which may cause dark spots to appear in the product.

Efficiency of bone separation, overall capacity and simplicity are certainly other features that should be examined in equipment of this type. All separation machines should be thoroughly washed at least once each day. Thus, simplicity is an important factor to keep in mind in terms of ease of cleaning. The presence of exposed iron in contact with the flesh will greatly accelerate fat oxidation in the product during storage.

COST CONSIDERATIONS

The economics of producing minced fish or minced fish products will vary according to the individual situation of each processor. The availability of raw material is a primary consideration. Many species, such as spot, mullet and croaker, are available in quantity at very low prices and can be processed into excellent minced fish products. However, heading, gutting and washing equipment are required to properly prepare these low cost, whole fish for mechanical deboning. Conversely, some processors currently filleting more expensive species, such as flounder and trout, have a ready-made source of material for mechanical deboning in the form of fillet wastes which they may now be discarding. These processors, therefore, would require less initial investment to start production of minced fish.

Yield is an important consideration in determining the final costs of the product. On headed and gutted fish yields typically range from 40 to 70 percent. In general, yields vary considerably depending on the species, whether whole fish or filleting wastes are being used, and on the type
of machinery used. Figure 6 provides a handy reference chart for the calculation of product cost when the approximate yield and initial cost of the fish are known.

Figure 6. Mechanically deboned fish meat prices in relation to round prices. (Feb. 1978 prices)

A short list of the factors that typically should be considered in "costing-out" a particular operation would include:

(1) Raw material costs and availability.
(2) Equipment costs, including operation, maintenance and repair.
(3) Labor, fringe benefits, etc.
(4) Yields
(5) Packaging, storage, shipping costs.
(6) Advertising, marketing and promotion costs, etc.
(7) Market price of product (based on demand).

Many processors may find production of minced fish to be a means of continuing production during off seasons by using less desirable but more available species. Others may use it as a tool to increase
profits from by-products of their normal operations. Many producers of processed meat products may find that they already possess much of the equipment needed to product new product lines from minced fish. The costs of minced fish production or utilization should, therefore, be viewed relative to the total operation of a processing or packing plant.

QUALITY CONTROL

Production of minced fish from underutilized species and fish product trimmings offers the seafood packer and processor potentially great economic gains. However, as this technology is introduced to the American consumer, attention must be focused on product quality to assure widespread acceptance of minced fish products. Mincing of fish should not be taken as merely a method of converting low quality seafood into a saleable item. Such a practice will only serve to brand all minced fish products as substandard in the eyes of consumers. Thus, at this stage in the development of the minced fish industry, it is essential that emphasis be placed on product quality maintenance. (Fig. 7)

Sanitation

Minced fish is an ideal growth medium for micro-organisms of all types. The mincing operation evenly distributes surface bacteria throughout the meat mass, and provides a source of contamination from machines which either have not been properly sanitized or which may be recontaminated from previous lots of fish processed the same day. Producers of minced fish would do well to learn from the costly experiences of those involved with ground beef, pork sausage and deboned chicken production where it was found that overlooking even small details in plant sanitation resulted in greatly reduced shelf-life and product acceptance by consumers.
Figure 7. Mincing operation: a) filleting frames b) minced flesh c) bone and waste. (photo courtesy of National Marine Fisheries Service).

The critical points in sanitation involve the thorough cleaning and washing of raw material, proper worker hygiene, a clean processing environment, and daily (or more frequent) breakdown and cleaning of all equipment which comes in contact with the product. Processed minced fish should always be handled and stored away from incoming or stored raw fish or processing wastes. Heat treatment is not recommended for lowering bacterial contamination in most cases, as denaturation of fish protein will render the minced fish unsuitable for most products requiring further processing.

**Bone Content**

In the drum-type separation machine, the occurrence of bone fragments or particles in coarse minced fish is a function of the alignment of the bones in the machine and the diameter of the perforations on the separating drum. Transverse alignment of bones across the drum perforations may lead to small fragments being pressed through the holes along with the flesh. The size of these fragments will be proportional to the diameter of the drum holes. Axial alignment of the bones above the drum openings may result in larger fragments being partially pressed through the opening before being sheared off.
The degree to which bone fragments become objectionable depends on the size and pliability of the fragments. Potentially harmful bones may be defined as those which leave a clear indentation when pressed axially between the fingers. However, heat processing of some products, such as in canning, may render these bones harmless. Several procedures are currently available for routinely determining the bone content of the minced fish. Two which have been tested and found to be satisfactory are the gravity flotation method (Patashnik et al., 1974), involving the blending and flotation of the meat particles, and the chemical digestion method (Dingle et al., 1974), in which the meat is dissolved away from the bones.

In the auger or piston type deboner, the small diameter of the extrusion openings generally prevent discernable bone fragments from passing into the minced flesh. However, grinding during the process will elevate the calcium content of the deboned flesh beyond that normally found in fish deboned by hand. Bone content is roughly calculated as the calcium content multiplied by four. In general, a calcium content of no more than 1 percent is recommended for health reasons, although a normal working limit of 0.5 percent would be advisable to insure that regulatory requirements are met. Calcium content is normally assessed by atomic absorption spectrophotometry; thus, obtaining access to the services of a reliable laboratory is a necessity.

Product Appearance

The presence of dark spots in minced fish due to the retention of bits of skin, belly lining, or organ meat in the flesh is esthetically objectionable and limits the application of the product.

Minced fish intended for use in finely comminuted products may be easily strained to remove such particles. But because the size of the meat particles is greatly reduced during straining, this technique is not recommended for the manufacture of minced fish blocks for the fish stick trade. In this case, the only remedy is to carefully prepare the fish prior to deboning to avoid spotting. The addition of brushes to gutting machines will generally facilitate the removal of the belly lining and any remaining internal organs.
The blood content of minced flesh can vary widely among different species of fish. As a result, the color of minced fish can range from dark to white. Once again, the end use will dictate the color requirements of the product. Production of fish sticks requires very light to white flesh to meet consumer preferences, while processed items, such as sausage or luncheon meat, are traditionally of a darker color. Removal of the backbone and artery, as well as the use of whole fish for deboning, facilitates production of light colored meat. Washing of minced fish will leach out a large proportion of the pigment if performed in conjunction with or immediately after deboning. The addition of a commercial whitener, composed largely of starch and vegetable fat, may also be used to partially whiten minced fish to the desired color.

PRODUCT APPLICATIONS

Minced fish offers processors exciting possibilities for new product lines as well as product diversification. Figure 8 illustrates some of the many products which may be produced with minced fish. Test marketing of one-pound minced blocks directly to consumers in the retail market has shown excellent initial acceptance and high repeat sales (Goodrich and Whitaker, 1977).

From the consumers' perspective, minced fish in its primary form is a versatile yet economical product. It can be used to replace filleted fish in recipes for soups, chowders, casseroles and in a wide variety of other seafood dishes. Similarly, minced fish can be profitably added by the processor to pot pies, patties, chowders, sauces and a host of other canned or frozen convenience foods currently offered in supermarkets and to institutional feeding programs. In one taste test conducted by researchers at North Carolina State University in conjunction with a school lunch program, students rated highly a seafood pizza sauce made with minced fish.
Minced fish is an ideal extender for crabmeat in patty formulations. It can be combined with shrimp bits, oyster pieces or other, more expensive seafoods and pressed, formed or extruded into a variety of shapes and sizes to create novel seafood items. One such item, a breaded shrimp-fish portion, is currently being marketed in Oregon. Other states also report interest in related products on the part of their industries.

Naturally, minced fish may also be used alone or in combination with filleted or flaked fish to produce excellent breaded fish sticks and portions. Such products are currently being produced and marketed nationally. These products not only underprice fillet products, they maintain excellent quality and appeal.

FROZEN STORAGE OF MINCED FISH

Seasonal fluctuations in supplies of fish require that a certain quantity of minced fish be stored for future use. Unless a canned product is being produced, freezing is the first choice of storage methods to assure proper gelling of the fish proteins in the production of texturized products.

Minced fish intended for use in fish sticks (Fig. 9) should be frozen in uniform blocks. However, minced flesh intended for use in other products may be frozen in any size or shape container. The choice of additives or pretreatments designed to extend the frozen storage life of fish will depend on the species of fish, the size of the minced fish particles and also on the end use of the minced fish. The actual freezing method selected will vary with each type of minced fish produced and for each intended end use.
Production of Minced Fish Blocks for the Fish Stick Trade

Frozen blocks may be made by plate freezing from a mixture of different species. When this is done, the species content must be identified on each block. So-called "laminated" blocks, consisting of both minced fish and fish fillets, may also be used to improve the fish stick texture. In some instances it has been reported that incorporation of finely comminuted minced flesh as a binder actually improves the cohesiveness and texture of fish sticks.

Research has also shown that frozen blocks of minced fish deteriorate about twice as quickly as blocks prepared from fillets during frozen storage. The loss of structure in the flesh causes dehydration to occur more rapidly in minced blocks. However, an overwrap of plastic film, preferably a saran or another oxygen-tight film, in addition to the wax carton normally used in packaging will prevent this.
The use of oxygen-tight film will also help prevent the effects of external oxygen in causing oxidative changes in the minced tissue affecting both flavor and texture. Addition of antioxidants to the minced tissue may also be necessary to control fat oxidation resulting from the large amount of oxygen incorporated during the mincing operation. Fatty species of fish are especially prone to develop oxidative flavor changes. Problems have been encountered with incorporating the fat soluble pheonolic antioxidants, such as butylatedhydroxyanisole (BHA) and butylatedhydroxytoluene (BHT), evenly throughout the fish flesh. Sodium ascorbate (vitamin C) and erythorbate are more easily incorporated and appear to be a more effective control of fat oxidation.

Washing of minced fish flesh is another method of reducing fat oxidation during frozen storage. While washing improves the gel-forming ability of some species, such as croaker, it may cause significant flavor and protein losses in other species.

There are other problems associated with the texture of minced fish blocks, including excessive thaw drip, rubbery texture and lack of cohesiveness. These undesirable traits all result from denaturation of the muscle proteins during frozen storage. This denaturation is accelerated by breakdown products of certain compounds present in the fish. For example, kidney tissue may contain an enzyme which speeds up the formation of these breakdown products. This is another reason that residual kidney tissue should be completely removed.

Addition of phosphate mixtures helps alleviate texture problems to some degree in both fillet and minced blocks; however, use of pyrophosphate, a common ingredient of most commercial phosphate mixtures, may actually contribute to the rubbery texture in minced blocks. Addition of sugars or polyalcohols at a level of 3-7 percent will also help mitigate problems with protein denaturation. Some manufacturers have found that the incorporation of a small amount of
textured vegetable protein (TVP) to frozen minced fish improves the textural characteristics of fish sticks. The texture of certain soft-fleshed species of fish, such as flounder or trout, may be improved by mixing with fish of firmer texture.

Frozen Storage of Minced Fish for Other Uses

Minced fish intended for use in gel-type products may be strained and highly comminuted before freezing. To insure that good gelling characteristics are present during final processing, it is essential to prevent protein denaturation and gelation during frozen storage. One way to guard against protein denaturation is to incorporate greater quantities of sugar or other additives into the frozen tissue. During processing, fresh tissue is then combined with the frozen tissue so that the additives have no adverse effects on flavor. The Japanese advocate the addition of sodium citrate of salts of other organic acids to the frozen "surimi" (commingled minced fish) to prevent gelling of the mixture during storage. Storage gelling destroys the ability of the minced fish to gel (bind) properly during processing. Addition of antioxidants and the use of airtight packaging, as mentioned earlier, will reduce oxidative deterioration during storage.

Minced fish or "surimi" may be frozen in any shape or size container; however, the dimensions of the frozen material should be small enough to insure rapid freezing by whatever method is chosen. The frozen material must also be of a size compatible with the size reduction equipment used to reduce the material to small chunks before processing. One novel approach eliminated the need for size reduction through the use of rapid freezing. In this method, a thin sheet of minced fish paste is frozen on a revolving drum freezer. Once frozen, the sheet is cut into smaller chips. The chips are then bagged and are ready for processing. No further size reduction is necessary.
Production of Gel-type Products

Perhaps the greatest potential for marketing of minced fish lies in the area of gel-type products. These products resemble the higher fat emulsion-type products manufactured from red meats or chicken such as hot dogs, luncheon meats and jerky. (Figure 10) Table 2 lists a few of these products made with minced fish and their preparation.

Table 2. Description of Some Gel-type Products.

1) Luncheon Loaf
   Ingredients: Deboned fish tissue, nonfat dry milk, salt, spices, natural smoke flavoring, certified artificial color added.
   Preparation: Partially thawed minced croaker tissue is chopped with ingredients to solubilize muscle proteins so that a viscous gel is formed. The mixture is stuffed in casings or packed in aluminum pans and cooked.

2) Sea Pup (Hotdog)
   Ingredients: Omit spices for luncheon loaf.
   Preparation: Form gel as with luncheon loaf. Stuff into casings and smoke, cook.

3) Jerky
   Ingredients: Omit spices from luncheon loaf.
   Preparation: Ingredients are chopped to form a viscous gel and packed in aluminum pans. Then steam cooked, sliced, smoked and dried.

4) Fish Bits
   Ingredients: Deboned croaker tissue, nonfat dry milk, tapioca, salt, spices, natural smoke flavoring.
   Preparation: Chopped, cooked, ground and dried.

5) Meat Base for Spread, Salad and Pizza Topping
   Ingredients: Same as luncheon loaf.
   Preparation: Luncheon loaf is prepared and ground.
(6) Spread
Ingredients: luncheon loaf
2 teaspoons chopped pickles
1 teaspoon chopped onion
2 tablespoons mayonnaise
1 chopped hard-boiled egg
Preparation: Blend to fine texture.

(7) Salad
Ingredients: luncheon loaf
\(\frac{1}{4}\) cup mayonnaise
\(\frac{1}{4}\) cup chopped celery
2 tablespoons sweet pickles
2 teaspoons chopped onion
3 hard-boiled eggs
Preparation: Stir to mix.

Gel products are prepared by first finely comminuting (chopping) the deboned meat with spices, flavorings and possibly added binders such as TVP to achieve a homogenous mass. Salt is added during chopping to extract the proteins responsible for firm binding and good texture in the final product. The raw gel is then stuffed into casings or pans and cooked, possibly with smoking, to produce the finished product. Rapid heating to a high internal product temperature (185°F) is necessary to inactivate enzymes present in many fish which can break down the muscle proteins and prevent the formation of a firm texture in the final product. Jerky may be made by slicing the cooked gel and drying/smoking the slices for a short period.

Gel products produced in this manner from minced fish possess a firm texture and bite. The color will vary from off white to golden brown, depending on the blood content of the tissue and any coloring agents added, such as approved food coloring. Smoking or liquid smoke addition enhances the brown luster of the outer product surface and improves its overall appearance. At present it is unlikely that FDA will permit nitrite addition to fish gel products. In light of the current controversy over nitrosamine formation in meat products, however, the absence of nitrites may be considered an advantage in the marketing of these products. Because nitrites are not present, vacuum packaging of gel products made with minced fish is not recommended, since this poses a greater botulism hazard.
Figure 10. Gel products made from minced fish.

JERKY

SEA PUPS
Production of gel products from minced fish allows a processor to add a seafood flavored counterpart to the meat or chicken product lines he may already offer. The delicate, smoked seafood flavor is a natural addition to such product lines as hot dogs, thin sliced luncheon meats, jerky, dips and salads. Viewed in this light, minced fish is not a cheap substitute or extender for meat or chicken, but offers an exciting change in flavor for traditional product forms.

While gel products prepared from minced fish do compete favorably in price with their meat and chicken analogs, the biggest advantage is in nutrition. Table 3 reveals that gel products prepared from minced croaker are far lower in fat and calories and higher in protein than the traditional processed red meat items. Tables 3 and 4 and Figure 11 show that in the croaker gel most of the calories are obtained from protein and not fat or carbohydrate, as is the case for processed products prepared from red meat. The high protein, low fat nature of minced fish, in addition to the high polyunsaturation of the fat present, offers nutritional advantages for utilizing this material in gel-type products.

Shelf stability of gel-products will depend on the species of fish used, the use of additives or preservatives, and on the packaging and method of storage. Fatty fish generally yield products with a shorter storage life due to fat oxidation and rancidity development. However, this may be offset to a certain extent by the addition of various antioxidants. Proper packaging is also essential in preventing freezer burn and oxygen-related degradation of frozen products or drying of cooler-stored products.

As previously mentioned, it is recommended that these products be marketed as flavor additions to existing lines and not as cheap substitutes for a more acceptable product. The product image which is conveyed to the public as these products are introduced to the marketplace is critical in determining the ultimate success of minced fish.
<table>
<thead>
<tr>
<th>Product</th>
<th>% Protein</th>
<th>% Fat</th>
<th>% Moisture</th>
<th>% Carbohydrate</th>
<th>% Ash</th>
<th>Total Calories Per 100 gms</th>
<th>% Protein Calories Total Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Croaker - Minced tissue</td>
<td>17.59</td>
<td>2.00</td>
<td>78.72</td>
<td>---</td>
<td>1.69</td>
<td>88.36</td>
<td>79.23</td>
</tr>
<tr>
<td>Fish Loaf</td>
<td>17.97</td>
<td>2.16</td>
<td>73.11</td>
<td>0.93</td>
<td>5.83</td>
<td>95.04</td>
<td>75.63</td>
</tr>
<tr>
<td>Fish Jerky</td>
<td>58.95</td>
<td>7.30</td>
<td>17.00</td>
<td>3.61</td>
<td>13.14</td>
<td>315.94</td>
<td>74.63</td>
</tr>
<tr>
<td>Meatloaf</td>
<td>15.90</td>
<td>13.20</td>
<td>64.10</td>
<td>3.30</td>
<td>3.50</td>
<td>195.60</td>
<td>32.52</td>
</tr>
<tr>
<td>Frankfurters</td>
<td>12.40</td>
<td>27.20</td>
<td>57.30</td>
<td>1.60</td>
<td>1.50</td>
<td>300.80</td>
<td>16.49</td>
</tr>
<tr>
<td>Bologna</td>
<td>12.10</td>
<td>27.50</td>
<td>56.20</td>
<td>1.10</td>
<td>3.10</td>
<td>300.30</td>
<td>16.12</td>
</tr>
<tr>
<td>Salami (dry)</td>
<td>23.80</td>
<td>38.10</td>
<td>29.80</td>
<td>1.20</td>
<td>7.10</td>
<td>442.90</td>
<td>21.49</td>
</tr>
</tbody>
</table>

Table 3. Proximate composition of certain seafoods and meat products.
<table>
<thead>
<tr>
<th>Food Description</th>
<th>Calories (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minced fish tissue (croaker)</td>
<td>79.2</td>
</tr>
<tr>
<td>Fish loaf (croaker)</td>
<td>75.6</td>
</tr>
<tr>
<td>Fish jerky (croaker)</td>
<td>74.6</td>
</tr>
<tr>
<td>Pork meat (medium fat, cooked)</td>
<td>13.9</td>
</tr>
<tr>
<td>Beef meat (medium fat, cooked)</td>
<td>27.4</td>
</tr>
<tr>
<td>Beef (lean)</td>
<td>69.0</td>
</tr>
<tr>
<td>Chicken, total edible</td>
<td>25.5</td>
</tr>
<tr>
<td>Chicken, white meat</td>
<td>76.0</td>
</tr>
<tr>
<td>Egg, whole</td>
<td>33.9</td>
</tr>
<tr>
<td>Milk, skimmed, dried</td>
<td>42.7</td>
</tr>
<tr>
<td>Cheese, cottage</td>
<td>76.0</td>
</tr>
</tbody>
</table>

Table 4. Protein calories in percent of total calories for certain foods.
Figure 11. Total calories and percent protein calories as dependent on percent fat.
OUTLOOK FOR THE FUTURE

Minced fish production and utilization can cause a revolution in both the fishing industry and the marketplace. Skepticism regarding the potential for minced fish utilization is slowly being overcome much as it was in the case of deboned poultry meat a decade ago.

Elimination of waste, more efficient use of our existing resources, the production of new and nutritious foods as well as the economic advantages to both the producer and consumer are just a few of the benefits of minced fish. Quality production and imaginative marketing will help insure that this valuable resource is more fully utilized in the future.
REFERENCES


An annotated bibliography which cites literature covering all aspects of minced fish production and utilization is now available through the University of North Carolina Sea Grant College Program. Price: 75¢. Residents of North Carolina may request a single copy free of charge. When ordering, ask for Publication # UNC-SG-77-17.