

# Evaluation of Methods to Determine the Proportions of Fillets and Minced Fish Flesh in Mixed Fish Blocks

J. PERRY LANE and THOMAS J. CONNORS

## Introduction

Some foreign countries, most notably Norway, Germany, and Great Britain, add minced fish to fillet blocks. It is claimed that the binding properties of the minced fish reduce breakage during the manufacture of fish sticks and portions from these blocks, as well as making more complete use of the fish by recovering flesh from trimmings and other waste generated by the filleting operation. Currently, the United States Standards for Grades of Frozen Fish Blocks make no provision for grading mixed fillet-mince blocks. Blocks may be all fillets or all minced fish but not a mixture of the two.

Some U.S. producers of fish sticks and portions have expressed an interest in using mixed fillet-minced fish blocks and requested the U.S. Department of Commerce's National Marine Fisheries Service (NMFS) (preparing agency for the U.S. Grade Standards for Fishery Products) to develop a Grade Standard for mixed blocks. Since establishing some level of minced fish content will be an important quality criteria, it becomes necessary to select or develop a method for determining the amount of minced fish in the block.

To facilitate the development of Grade Standards, NMFS has a policy of establishing a technical working group for each standard. The group is made up of both government and industry representatives, the latter being from the segment of the fish industry connected with the product under consideration. In the case of the Fish Block Technical Working Group, a subcommittee on methodology was formed for the express purpose of

working with the NMFS Northeast Fisheries Center's Gloucester Laboratory to evaluate, refine, or devise and recommend a method of determining the amount of minced fish in a mixed fillet-mince block. The committee and Laboratory personnel identified four methods for evaluation. One was from the Federal Republic of Germany (FRG) while the other three were Norwegian.

The methods were first screened for ease of use and adaptability to a production, or large-scale sampling situation. This report gives the results of the screening process for the four methods. For identification purposes, the methods are designated as FRG<sup>1</sup>, Norwegian<sup>2</sup>, Modified Norwegian<sup>3</sup>, and Bergen<sup>4</sup>.

## Materials

Fifty mixed fillet-mince blocks were obtained from Norway through the cooperation of Robert Tinay of Frionor Kitchens, Inc., of New Bedford, Mass. These blocks were from a normal production run and were reported to contain an average of  $20 \pm 5$  percent minced fish. It should be emphasized that we did not require a precise known amount of minced fish since our primary interest at this stage was to evaluate the methods

<sup>1</sup>N. Antonacopoulos, bundesforschungsanstalt Fur Fisherei, Institut Fur Biochemie und technologie, Palmaille 9, D-2000 Hamburg, Germany, Federal Republic. Pers. commun.

<sup>2</sup>F. J. King, NMFS Gloucester Laboratory, Emerson Avenue, Gloucester, MA 01930. Pers. commun.

<sup>3</sup>G. R. Tinay, Frionor Kitchens, Inc., Herman Melville Blvd., New Bedford, MA 02741. Pers. commun.

<sup>4</sup>J. Gjerde, Sentrallaboratoriet Fiskeriidirektoratet, mollendalsvegen 4, postboks 185, 5001, Norway. Pers. commun.

for practicality of use. The most practical method would then be selected, modified if needed, and then evaluated for accuracy. The procedure used and the results obtained will be given for each method.

## FRG Method

### Procedure

#### Principle

Frozen subsamples are placed in a watertight bag and thawed in water. After the thawed fish is drained and weighed, the fillets are held with a fork while the minced fish is scraped off with a spatula. The minced fish and fillets are collected separately, weighed, and the proportion of each calculated.

#### Apparatus

- 1) A water bath set at 20°-25°C (70°-80°F);
- 2) U.S. No. 8 Standard sieve;
- 3) Fork and rubber-edged spatula;
- 4) Balance sensitive to 0.28 g or 0.01 ounce.

#### Determination

While the fish block is still frozen, cut two 1 kg (2-pound) samples from opposite ends and two 1 kg (2-pound) samples from the middle of the block. The total weight of the sample should be at least 4 kg (8 pounds). Weigh the sample on a

The authors are with the Gloucester Laboratory, Northeast Fisheries Center, National Marine Fisheries Service, NOAA, Gloucester, MA 01930. Mention of trade names or commercial firms in this article does not imply endorsement by the National Marine Fisheries Service, NOAA.

scale of adequate capacity with a sensitivity of 0.28 g (0.01 ounces) (weight = *A*). Cut the sample into portions weighing ~100 g (3.5 ounces). Place each portion in a watertight plastic bag of suitable size. Thaw the portions in a water bath at ~20°C (70°F) but not over 25°C (80°F) with gentle agitation of the water.

After thawing has been completed, take each portion, one at a time, and drain the exuded fluid (thaw drip) for 2 minutes on a preweighed U.S. No. 8 Standard circular sieve inclined at an angle of 17°-20°. Determine the weight of the flesh (weight *B*) using a scale of adequate capacity with a sensitivity of 0.28 g (0.01 ounces). Place the flesh on a plate and separate the minced flesh from the fillet flesh, using a fork to hold the fillet flesh and a soft, rubber-edged spatula to scrape off the minced flesh. Then weigh the fillet part (weight = *C*) and the minced part (weight = *D*) separately. After completing the separation of each thawed portion, add the weights of the fillet flesh and the minced flesh. To each sum add one-half the weight of the exuded fluid (thaw drip) (*A* - sum of *B* = *E*).

#### Calculations

1) Net weight of sample (*A*) - total frozen weight of all four portions of the sample;

2) Net weight of thaw drip (*E*) - weight of the frozen sample - weight of thawed-drained sample;

3) Percent minced fish (*M*) =

$$\left[ \frac{\text{Net weight of mince (D)} + \frac{1}{2} \text{ weight of thaw drip (E)}}{\text{Net weight of sample (A)}} \right]$$

× 100, or

$$M = \left[ \frac{D + \frac{E}{2}}{A} \right] \times 100.$$

#### Results and Discussion

The sample was obtained by cutting four pieces weighing ~1 kg each from one 16-pound block. After the four

pieces were weighed, each was cut into 10 pieces of ~100 g each. The 100 g portions were placed individually in plastic pouches and thawed in a water bath maintained at 22°C. After the portions were thawed, they were drained and the minced fish separated from the fillets according to the procedure described under "Determination". The results appear in Table 1.

Table 1.—Percent minced fish found in a sample of mixed fish-mince block using the FRG procedure.

Sample weight (A)	Weight (g)					Percent mince
	Drained weight (B)	Fillet weight (C)	Mince weight (D)	Thaw drip A - B or (E)		
3,610	3,267	2,991	276	343		12.4

The cutting, thawing, and separation of the 40 portions of ~100 g each into minced fish and fillets was very time-consuming. Nearly 4 hours were required to do the one sample. The percent of minced fish was found to be 12.4, well outside the reported range of 15-25 percent. Since only about one-half the fish block was used, the sample may not be representative of the true proportion of mince present in the block.

It was concluded that this method was too time-consuming to lend itself to a large-scale testing situation. Therefore, no further samples were analyzed using this method.

#### Norwegian Method

##### Procedure

##### Principle

An air-thawed fish block sample is separated by hand, drained, and weighed. After the drained weight is obtained, the sample is placed on a tray with 12 mm holes and the minced fish removed with a water spray. The remaining fillets are drained and weighed and the percent of minced fish calculated.

##### Apparatus

1) U.S. No. 8 Standard sieve, 30 cm (12 inches) in diameter;

2) Balance sensitive to 0.28 g (0.01 ounce);

3) Perforated tray with 12 mm holes;

4) Water spray nozzle to deliver a gentle water spray.

##### Determination

The sample size is at least 5 kg (10 pounds) or preferably an entire fish block. Thaw the sample. The thawed sample should not be held for more than 8 hours before examination.

After thawing has been completed, take some of the fillets or fillet sections (pieces), place in single layer, and drain the exuded fluid (thaw drip) for 2 minutes on a preweighed U.S. No. 8 Standard circular sieve inclined at an angle of 17°-20°. Use a 20 cm (8-inch) sieve for <0.9 kg (2 pounds) of fish flesh and a 30 cm (12-inch) sieve for larger quantities up to the capacity of the sieve to hold a single layer of fillets or fillet sections (pieces). Determine the weight of the drained flesh (weight *A*) using a scale of adequate capacity with a sensitivity of 0.28 g (0.01 ounce).

Place the flesh on a tray perforated with holes of 12 mm diameter. Spray the flesh with a gentle spray of cold water until no further minced fish flesh will pass through the holes. A soft, rubber-edged spatula may be used to help scrape off the minced fish flesh. Transfer the remaining fish material to a preweighed No. 8 sieve, incline it at an angle of 17°-20°, and allow it to drain for 15 minutes. Weigh the remaining fish material (weight = *B*).

##### Calculations

1) Net weight of sample (*A*) - total weight of all drained fish flesh;

2) Net weight of fillets (*B*) - total weight of all drained fillet material after separation from mince with a water spray;

3) Percent minced fish (*M*) =

$$\left[ \frac{\text{Net weight of sample (A)} - \text{net weight of fillets (B)}}{\text{Net weight of sample (A)}} \right]$$

× 100, or

$$M = \left[ \frac{A - B}{A} \right] \times 100.$$

## Results and Discussion

Ten fish blocks were examined by this method. The sample unit was the entire fish block. The blocks were thawed overnight on trays at room temperature (68°F or 20°C). The thawed blocks were individually separated and drained and the net weights obtained. Then the minced fish was separated by hand from the fillets with a water spray and the hands (no spatula used); otherwise the procedure given in "Determination" was followed. The water spray was used at the rate of 2 gallons/minute. It required 7 hours to run all 10 blocks at an average of 42 minutes/block. The results are given in Table 2.

Table 2.—Percent minced fish found in ten samples of fish blocks using the Norwegian procedure.

Block no.	Weight (pounds)			Percent minced fish
	Frozen block	Drained block	Drained fillets	
1	16.6	14.98	10.99	26.6
2	16.6	15.65	11.21	28.3
3	16.6	15.34	12.85	16.2
4	16.5	15.10	12.51	17.2
5	16.6	15.36	11.57	24.7
6	16.6	16.12	11.10	31.1
7	16.6	15.80	10.65	32.6
8	16.6	14.65	11.55	21.2
9	16.6	15.07	10.61	29.6
10	16.3	14.17	10.73	24.3
		Mean		25.2%
		Range	16.2-32.6	
		S.D.	5.6	
		Variance	28.3	

The mean percent mince, 25.2, was just above the reported upper limit of the added minced fish content of 25 percent. The time required, 42 minutes/block, appears too great to be of practical value as a production test method.

### Modified Norwegian Method

#### Procedure

##### Principle

A fish block is air thawed, drained, and the net weight determined. The block is immersed in a cold-water bath and the fillets are separated from the mince by hand. The fillets are placed on an inclined tray, and the excess water is removed and weighed. The proportion

of minced fish is calculated from the drained weight of the block and the fillets.

#### Apparatus

- 1) Shallow trays large enough to hold one fish block for thawing;
- 2) Container large enough to hold one fish block plus ~ 5 gallons of water;
- 3) Balance sensitive to 0.28 g or 0.01 ounce.

#### Determination

The sample size is an entire fish block. Thaw the sample on a preweighed tray in air at ambient (room) temperature (this generally takes overnight). After the block has thawed completely, it should not be held for more than 8 hours before examination. Drain the exuded fluid (thaw drip) by inclining the tray at an angle of 17°-20°. Determine the weight of the drained flesh (weight = *A*) using a scale of adequate capacity with a sensitivity of 0.28 g (0.01 ounce).

Immerse the drained flesh in a tub of cold tapwater. Separate the fillets by hand and wash the minced fish flesh from the fillets. Place the washed fillets on the upper section of a preweighed tray which is inclined at an angle of 17°-20°. Allow the fillets to drain for 15 minutes. Remove the wash water from the lower section of the tray, then weigh the drained fillets (weight = *B*) using a scale of adequate capacity with a sensitivity of 0.28 g (0.01 ounce).

#### Calculations

- 1) Net weight of sample (*A*) is the weight of the thawed, drained fish block;
- 2) Net weight of fillets (*B*) is the weight of the drained fillets after they have been separated from the minced fish in the water bath;
- 3) Percent minced fish (*M*) =

$$\left[ \frac{\text{Net weight of sample } (A) - \text{fillet weight } (B)}{\text{Net weight of sample } (A)} \right]$$

× 100, or

$$M = \left[ \frac{A - B}{A} \right] \times 100.$$

## Results and Discussion

Ten blocks were examined by this method. The blocks were thawed overnight on preweighed aluminum trays, ambient temperature 70°F (21.1°C). The blocks were drained, weighed, and placed in a container of cold water. It was found that a ratio of about two parts water to one part fish (4 gallons of water to one 16-pound block) provided enough water to satisfactorily wash the minced flesh from the fillets. The fillets were drained and weighed according to the procedures given in the "Determination" section.

About 4 hours were required to analyze the 10 blocks or about 24 minutes/block. Considerable time was spent in waiting for the mandated drain periods to be completed. The results appear in Table 3.

Table 3.—Percent minced fish in ten fish blocks using the Modified Norwegian procedure.

Block no.	Weight (pounds)			Percent minced fish
	Frozen block	Drained block	Drained fillets	
1	16.1	14.96	13.21	11.7
2	16.9	16.32	13.57	6.8
3	16.1	16.29	13.87	14.9
4	16.1	15.02	12.91	14.0
5	16.1	15.55	12.62	18.8
6	16.9	15.42	13.26	14.0
7	16.1	14.88	12.11	18.6
8	16.1	16.07	11.92	25.8
9	16.1	15.50	10.93	29.5
10	16.1	15.15	10.64	29.8
		Mean		19.4%
		Range	6.8-29.8	
		S.D.	6.6	
		Variance	39.7	

The mean percent, 19.4, was very close to the reported mean, 20 percent, of the lot of fish blocks. The method required no special equipment, was simple, and the time was the best of any of the four methods tested.

### Bergen Method

#### Procedure

##### Principle

Samples of frozen fish blocks are placed in plastic bags and thawed in cold

water. The samples are drained and net weight is determined. The sample is mixed with water and poured into stacked sieves. A water spray is used to separate minced fish from fillets. The fillets are retained on the coarse sieves (the mince on the smallest one). Composition of the sample is calculated using the combined fillet weight of the three coarser sieves.

#### Apparatus

1) A set of sieves containing 5, 12, 20, and 50 mm holes, respectively. Perspex is recommended as a suitable sieve material. The distance between the holes should be equal to or slightly greater than the diameter of the holes. The sieves should be strong enough and have an area large enough to hold at least 3 kg (6.6 pounds) of fish in a single layer of fillets;

2) A frame to hold the sieves, with 50 mm sieve on top, the 20 mm sieve below it, the 12 mm sieve below the 20 mm sieve, and 5 mm sieve below the 12 mm sieve;

3) A water sprinkler which provides a suitable area of spray and a delivery of 5-10 gallons (20-40 l) of water/minute;

4) A scale of adequate capacity with a sensitivity of 0.71 g (0.025 ounces).

#### Determination

The sample size is at least 4-6 kg (8-12 pounds) cut in ~ 1 kg (2-pound) units from four or more representative locations of a fish block.

Thaw the frozen sample in cold water in a plastic bag overnight in a refrigerator (~ 2°C or 36°F), drain for 15 minutes on a wire mesh screen inclined at an angle of 17°-20°. Weigh the drained sample (weight = *A*). Thawed sample should not be held more than 8 hours before examination.

#### Calculations

1) Net weight of sample is the weight of the thawed, drained block (*A*);

2) Net weight of the fillets is the sum of the weight of the fillets on the 50, 20, and 12 mm sieves (*B* + *C* + *D*);

3) Percent minced fish (*M*) =

$$\left[ 1 - \frac{\text{Net weight of fillets } (B + C + D)}{0.96 \text{ Net weight of sample } (A)} \right]$$

× 100, or

$$M = 100 \times \left[ 1 - \frac{B + C + D}{0.96 A} \right]$$

#### Results and Discussion

Instead of using the 8-12 pound sample unit called for, we used the entire 16-pound fish block. The sieves were made by drilling holes in aluminum trays 26 × 18 inches. A total of 10 samples were analyzed. In doing the first sample, it was found that placing the fish block in a plastic bag in 36°F water resulted in complete glaze over the block after 12 hours. It was necessary to spray the block several minutes to remove the glaze. The block was only partially thawed. We also found that a spray of even 2 gallons/minute to separate the mince from the fillets was too strong and some of the fillets were forced off the sieves.

For the remaining 9 blocks, tap water at 52°F was used and the thaw time extended to 15 hours. Even under these conditions there was some ice glaze on the blocks and it was necessary to add warm water to each pan to remove the glaze. It required 1 hour and 20 minutes to do the first block and 9 hours and 45 minutes to do the other nine blocks (1 hour and 5 minutes per block). The results of this examination appear in Table 4.

The mean percent minced, 22.6, was well within the reported range of minced fish content for the blocks. Special equipment was required in the form of a set of four sieves and a frame to hold them, refrigeration facilities, and pan to hold the water and blocks for thawing. Over an hour was required to do the examination on one block.

#### Conclusions

Four methods for determining the proportions of minced fish in a mixed

Table 4.—Percent minced fish found in ten samples of fish blocks using the Bergen procedure.

Block no.	Weight (pounds)			Percent minced fish
	Frozen block	Drained block	Drained fillets	
1	16.42	16.33	11.72	25.2
2	16.47	17.05	14.08	14.0
3	16.45	16.63	12.17	23.7
4	16.52	16.69	12.02	25.0
5	16.52	16.63	12.92	19.0
6	16.44	16.81	11.59	28.2
7	16.53	17.16	12.47	24.3
8	16.27	16.34	12.44	20.7
9	16.58	16.88	13.78	14.9
10	6.27	16.06	10.52	31.8
			Mean	22.6%
			Range	14.0-31.8
			S.D.	5.6
			Variance	28.4

fillet-mince fish block were evaluated. This evaluation was to determine the suitability of the methods for use in in-plant production situations or where relatively large numbers of samples would be examined. At this stage, the accuracy of the method was not a primary consideration since the actual content of minced fish in each block tested was not known. For ease of identification, the four methods were designated FRG, Norwegian, Modified Norwegian, and Bergen.

The FRG and the Bergen methods were deemed unsuitable because of the excessive time required to make the determination. The FRG method had the further disadvantage of requiring the preparation of 40 small subsample units for each sample and the use of a water bath. The Bergen method required refrigeration facilities, an excessively long thawing period, and four sieves plus a stand or rack to hold them.

Of the two remaining methods, the Norwegian and the Modified Norwegian, the latter was considered the most practical and was selected for further evaluation of its accuracy. The Modified Norwegian method required the least time to carry out and was also most accurate with a mean of 19.4 percent reported for the lot of blocks of 20 percent minced fish. The next phase of this study will be to consider possible refinements to the method and testing it for accuracy on blocks of known minced fish content.