

# Assessing the Accuracy of a Method to Determine the Amount of Minced Fish in Mixed Mince-Fillet Fish Blocks

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## Introduction

Some domestic producers of fish sticks and portions have expressed an interest in using fish blocks made from fillets and minced fish in place of the more traditional all-fillet fish blocks. Since the United States Standards for Grades of Frozen Fish Blocks have no provision for grading mixed blocks, such products could not be graded under the U.S. Department of Commerce Voluntary Fishery Product Inspection Program.

As a result, the Gloucester Laboratory of the National Marine Fisheries Service's Northeast Fisheries Center, preparing agency for U.S. Grade Standards for Fishery Products, began work to develop a method for determining the amount of minced fish in a mixed block. This effort was undertaken in collaboration with an industry-government technical working group on fish blocks. The first step was to gather information on existing methods and evaluate them for practicality of application (Lane and Connors, 1984). The method selected as the most promising was called, for purposes of identification, the "Modified Norwegian" method.

Once it was determined that this method appeared practical for commercial use, the next step was to evaluate its accuracy. Further preliminary work with the method resulted in a few minor changes in procedure. This report presents the results of testing the revised method

on fish blocks of known proportions of minced fish and fillets.

## Materials

Five hundred pounds of scrod cod, *Gadus morhua*, (1.5- to 2.5-pound fish) fillets were obtained from a local processor. One hundred pounds of fillets were put through a Yanagiya<sup>1</sup> meat-bone separator with 5 mm holes to produce the minced fish.

A total of 90 5-pound fish blocks were prepared in the laboratory. The 5-pound units were used for reasons of economy rather than the standard 16.5-pound block size used by industry. Except for the block size, we attempted to duplicate the commercial fish block as closely as possible. Since most fish blocks contain 0.5 percent tripolyphosphate (TPP) as a moisture retainer, a stock solution of TPP was made by dissolving 700 g of TPP in 8.3 l of distilled water to give a 7.77 percent TPP solution. The solution was added at the rate of 156 g per 5-pound block. The weight of the solution was not used in calculating either true input percent minced fish nor in the subsequent calculation of the recovered minced fish.

The fillets were cut into about 3 pieces each to approximate the surface area of a commercial 16.5 pound block. The fillets and minced fish were weighed to the nearest 0.25 ounce. The fillets were then placed in a container and the TPP solution was added and mixed by hand for 15 seconds. At the end of this mixing time

there was no visible free TPP solution remaining in the container. Next, the minced fish was added and mixing continued for another 75 seconds.

The entire mixture was packed in 5-pound wax-impregnated boxes and placed in a plate freezer frame. When a frame was filled with 4 boxes, it was placed in a 34°F cooler. It required 2 hours to prepare 12 frames, or 48 boxes, the capacity of the plate freezer. At this time all 12 frames (48 boxes) were placed in the plate freezer at -40°F plate temperature. The blocks were removed after 3 hours, taken out of the frames, and stored at -20°F. A second batch consisting of 42 blocks was made, frozen, and stored in the same manner for a total of 90 5-pound blocks.

The input weight of minced fish and fillets for each block was recorded. Thirty blocks were made with 15 percent mince, thirty with 20 percent, and thirty with 25 percent minced fish. After being stored for one week, 10 blocks were selected at random from each of the three lots: 15, 20, and 25 percent. This procedure was repeated a second time resulting in 3 randomly selected lots of 30 blocks each. For the next three consecutive days, three different inspectors—two industry members from the technical working group and one person from the Gloucester Laboratory—each examined 30 blocks according to the following procedure.

## Procedure

### Principle

A fish block is air thawed, drained, and the weight determined. The block

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<sup>1</sup>Mention of trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

is immersed in a cold-water bath and the fillets are separated from the mince by hand. The fillets are placed on a perforated tray. The remaining water in the bath is poured through a sieve and any fillet pieces are removed from the minced fish and added to the tray. The fillets are drained for 15 minutes and weighed. The amount of minced fish is calculated from the drained weight of the block and the drained weight of the fillets.

#### Apparatus

- 1) Shallow tray large enough to hold one fish block for thawing,
- 2) Container of sufficient size to hold a fish block and 5 gallons of water,
- 3) Perforated drain tray with 3-8 mm holes covering the entire bottom, and a
- 4) Balance or scale sensitive to 0.25 ounce (7 g).

#### Determination

The sample size is an entire fish block. Thaw the sample on a preweighed tray in air at ambient (room) temperature (generally this takes overnight). After the block has been 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. Determine the weight of the drained fish flesh (weight = *A*) using a scale of adequate capacity with a sensitivity of 0.25 ounce (7 g). All blocks should be weighed at the same time of initial drained-weight determination. (For this study a second drained weight was obtained at the time each individual block was examined.)

Immerse the drained flesh in a tub of cold tap water (50-70°F). (Use a ratio of 2 parts water to 1 part fish by weight.) Separate the fillets by hand and wash the minced fish flesh from the fillets in the tub. Place the washed fillets on the upper section of a preweighed tray with 3-8 mm holes covering the entire bottom of the tray. Incline the tray at an angle (17-20°) to facilitate draining. Pour the water from the tub containing the minced

fish and small pieces of fillets through a U.S. No. 8 Standard sieve. Remove the fillet pieces from the sieve and place them on the drain tray with the fillets. Allow the fillets and pieces to drain for 15 minutes. Remove any excess 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 0.25 ounce (7 g).

#### Calculations

1) Net weight of sample (*A*) is the thawed, drained fish block obtained initially for Determination 1 or obtained at the time the individual block was examined for Determination 2;

2) Net weight of fillets (*B*) is the weight of the fillets and fillet pieces after 15 minutes drain time;

3) Percent minced fish (*M*) =

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

× 100, or

$$M = \frac{A - B}{A} \times 100.$$

#### Results and Discussion

After the 10 blocks from each lot of 15, 20, and 25 percent mince were randomly selected for each of three inspectors, the order in which each inspector examined the blocks was also randomized. The frozen blocks were weighed and placed on trays and left at ambient temperature (71-77°F) for 12 hours. This was done on 3 consecutive days with one inspector doing the examination each day. This was to determine the amount of variation in results among different examiners.

At the end of the 12-hour thawing period, the blocks were drained and the weight was determined for all 30 blocks. The blocks were then placed back on the trays and returned to a cooler at 35°F. The blocks were then removed one at a time for separation of mince and fillets. An assistant then obtained the drained weight of each

block a second time and placed the block in 1.25 gallons of cold tap water (63-68°F) in an aluminum tub where the fillets were separated from the minced fish by the inspector. The assistant did all the weighing, leaving the inspector free to do the actual separations. Two drain trays were used for the fillets so it was not necessary to wait for the 15-minute drain time to be completed before starting the next block.

The reason for obtaining the drained weight of the block twice was that in preliminary trials it was noted that the blocks continued to exude fluid (thaw drip) after the initial weighing. It required from 5 to 5.75 hours for the inspectors to complete the examination of the 30 5-pound blocks. The percent mince was calculated twice to see if the requirement that the drained weight of all blocks be taken prior to beginning the examination was necessary to determine the actual percent of minced fish present, or if the thaw drip that accumulated during the examination period had little or no effect on the results.

The actual input percent of minced fish for the 15 percent lot ranged from 14.5 to 15.4 percent with the mean 15.0 percent. The true range for the 20 percent lot was 19.9-20.2 percent with the mean 20.0 percent. For the 25 percent lot the range was from 24.8 to 25.3 percent and the mean was 25.0 percent. Table 1 compares the combined results from the three inspectors with the actual input of minced flesh. Determination 1 uses the initial drained weight of the blocks and Determination 2 uses the drained weight of the blocks obtained at the time of examination.

The greatest deviation from the true lot mean was 1.0 percent for the 20 percent lot under Determination 1. The means obtained using Determination 2 were closer to the input means than those obtained using the initial drained block weights under Determination 1. This would indicate that the procedure requirement that all drained block weights be determined prior to the beginning of the separation of mince from fillets is not

necessary. Not only is it not necessary, but the accuracy of the final calculations for percent minced fish is slightly less than the results obtained by weighing the drained blocks individually at the time of examination.

The other statistical parameters, standard deviation, variance, and range, were all greater for the inspectors' test results than for the actual input, but were remarkably consistent among the three lots. There was very little difference in these parameters between Determination 1 and 2.

As a further check on the inspectors ability to successfully determine the actual amount of minced fish using this method, the results from all three lots were combined and compared with the combined input values. These results are given in Table 2.

The statistical results reinforce the conclusion made for Table 1. The Determination 2 overall mean of 20.2 percent is closer to the true mean, 20 percent, than the mean of 20.7 percent found using Determination 1. Both the test standard deviation and variance are closer to the input figures than was the case when the three lots were considered separately in Table 1. Since the Determination 1 results are not as accurate as those obtained under Determination 2, only the results from the latter will be given for the remainder of this report.

Two other points of interest in determining the suitability and accuracy of this method as a means of determining the amount of minced fish in a mixed mince-fillet block are the amount of variation among inspectors and whether the results are affected by the amount of the minced fish in the block. Comparison of the statistical evaluation for the three inspectors and the three lots (levels of minced fish) with the input results is made in Table 3.

In all but one instance the means for each inspector for all three lots were within  $\pm 1$  percent of the true mean. The one exception was inspector two for lot two (20 percent) where the difference was 1.1 percent.

For lot one, the range of means for the three inspectors was from 14.4 to 15.7 percent, a spread of 1.3 percent. For lot two it was from 19.9 to 21.1 percent, a spread of 1.2 percent, and

Table 1.—Comparison of combined inspectors' determination of percent minced fish at three levels with actual input (N = 30)<sup>1</sup>.

Item	Determination 1			Determination 2			Actual Input		
	15%	20%	25%	15%	20%	25%	15%	20%	25%
Mean	15.6	21.0	25.3	15.0	20.7	25.0	15.0	20.0	25.0
S.D.	1.38	1.59	1.64	1.43	1.66	1.60	0.56	0.09	0.11
Variance	1.85	2.45	2.60	1.98	2.65	2.46	0.31	0.01	0.01
Spread	5.5	6.6	6.6	5.6	6.8	6.5	0.9	0.3	0.6
Range	12.3-17.8	17.2-23.8	22.7-29.3	11.7-17.3	16.7-23.5	22.4-28.9	14.5-15.4	19.9-20.2	24.7-25.3

<sup>1</sup>All figures are percent minced fish.

for lot three, from 24.6 to 25.2 percent, a 0.7 percent spread. It should be noted that there was considerable variation in the amount of experience the three inspectors had in doing this type of analysis. One inspector had very limited experience, one moderate experience, and one extensive experience. The experience level had no relationship with the accuracy of the results. Even with the variation in background the agreement among the three inspectors was very high.

As for the effect of level of minced fish in the blocks, it appears to have little, if any, bearing on the accuracy of the results. This would indicate that at least in the range of 15-25 percent minced fish this method would be acceptable.

To further compare the agreement among the inspectors, the data from all three lots were combined for each inspector and compared with combined input data. The statistical comparison appears in Table 4. The agreement among the 3 inspectors was even more striking when the data from the three lots were combined with a range of means of only 1.0 percent, from 19.6 to 20.6 percent. The greatest test difference between the combined mean for any one inspector and the true combined mean was only 0.6 percent for inspector number three. Inspector number one was within 0.4 percent and inspector two was within 0.3 percent. The raw data for both input and recovery are shown in Tables 5-7.

## Conclusions

The minced fish recovery method reported in this paper was selected over three other methods evaluated as being the most practical in terms of ease of application, equipment required, and time of completion. The purpose of this study was to evaluate

Table 2.—Comparison of the combined inspectors' results from all three lots with actual input (N = 90)<sup>1</sup>.

Item	Determination 1	Determination 2	Actual input
Mean	20.7	20.2	20.0
S.D.	4.28	4.39	4.11
Variance	18.1	19.1	16.72
Spread	17.0	17.2	10.8
Range	12.3-29.3	11.7-28.9	14.5-25.3

<sup>1</sup>All figures are percent minced fish.

Table 3.—Statistical comparison of individual inspectors and actual input of minced fish percent for three levels of minced fish: Determination 2 results<sup>1</sup>.

Lot	Insp.1 (N = 10)	Insp. 2 (N = 10)	Insp. 3 (N = 10)	Actual input (N = 10)
No. 1 (15%)				
Mean	14.4	14.8	15.7	15.0
S.D.	1.46	1.30	1.36	.56
Var.	1.93	1.53	1.67	.31
Spread	5.2	4.2	3.5	.9
Range	11.7-16.9	12.2-16.4	13.8-17.3	14.5-15.4
No. 2 (20%)				
Mean	19.9	21.1	21.0	20.0
S.D.	1.68	1.57	1.59	.09
Var.	2.53	2.22	2.28	.01
Spread	6.5	5.2	5.2	.3
Range	16.7-23.2	17.9-23.1	18.3-23.5	19.9-20.2
No. 3 (25%)				
Mean	24.6	25.1	25.2	25.0
S.D.	2.14	1.06	1.50	.11
Var.	4.11	1.01	2.03	.01
Spread	6.5	3.7	4.3	.6
Range	22.4-28.9	23.5-27.2	23.4-27.7	24.7-25.3

<sup>1</sup>All figures are percent minced fish.

Table 4.—Statistical comparison of combined data from three lots for the three inspectors with combined input data (Determination 2)<sup>1</sup>.

Item	Insp.1 (N = 30)	Insp. 2 (N = 30)	Insp. 3 (N = 30)	Actual input (N = 90)
Mean	19.6	20.3	20.6	20.0
S.D.	4.55	4.47	4.22	4.11
Var.	20.0	19.3	17.2	16.72
Spread	17.2	15.0	13.9	10.8
Range	11.7-28.9	12.2-27.2	13.8-27.7	14.5-25.3

<sup>1</sup>All figures are percent minced fish.

the method for accuracy using laboratory prepared 5-pound fish blocks with three levels of minced fish. The determinations were made on 10 randomly selected blocks from each of the three lots (levels of minced

**Table 5.—Input data and results of inspectors' examination of 5-pound mixed fillet-mince fish blocks, Lot 1, 15 percent mince level.**

Block No.	Input			Insp. no.	Inspector results (Determination 2)			
	Fillet weight <sup>1</sup>	Mince weight <sup>1</sup>	Percent mince		Drained block weight	Fillet weight	Mince weight <sup>2</sup>	Percent mince
1	67.75	12.25	15.3	1	81.25	70.75	10.50	12.9
2	68.00	12.0	15.0	2	82.25	72.25	10.0	12.2
3	68.00	12.25	15.3	3	79.0	67.25	11.75	14.9
4	68.0	12.25	15.3	1	81.0	71.50	9.50	11.7
5	68.0	12.0	15.0	1	81.0	69.25	11.75	14.5
6	67.75	11.50	14.5	1	81.50	70.0	11.5	14.1
7	68.00	11.75	14.7	1	80.00	66.50	13.5	16.9
8	68.00	12.25	15.3	3	82.50	68.50	14.0	17.0
9	68.00	11.75	14.7	3	83.25	69.50	13.75	16.5
10	68.25	12.0	15.0	2	83.50	72.25	11.25	13.50
11	67.50	12.25	15.4	3	80.00	66.50	13.50	16.90
12	67.25	12.0	15.0	2	83.50	72.25	11.25	13.5
13	68.00	12.0	15.0	2	82.50	69.25	13.25	16.1
14	67.75	12.0	15.0	2	82.50	69.0	13.50	16.4
15	67.75	12.0	15.0	3	82.25	69.75	12.50	15.2
16	68.25	12.25	15.2	1	83.25	70.0	13.25	15.9
17	68.00	12.25	15.3	2	81.50	68.75	12.75	15.6
18	68.00	12.25	15.3	3	81.50	70.25	11.25	13.8
19	67.75	11.75	14.8	3	79.50	65.75	13.75	17.3
20	68.00	12.0	15.0	3	81.75	68.0	13.75	16.8
21	67.75	11.75	14.8	2	78.25	67.0	11.25	14.4
22	68.25	12.0	15.0	1	80.0	67.75	12.25	15.3
23	68.00	11.75	14.7	2	76.50	65.25	11.25	14.7
24	68.00	12.0	15.0	2	77.50	66.0	11.50	14.8
25	67.75	11.75	14.8	1	79.75	68.0	11.75	14.7
26	68.25	12.0	15.0	2	79.25	66.50	12.75	16.1
27	68.00	11.75	14.7	1	78.75	67.0	11.25	14.4
28	68.00	12.0	15.0	3	76.25	65.75	10.50	13.8
29	68.00	11.75	14.7	1	77.25	66.5	10.75	13.9
30	68.00	12.0	15.0	3	78.0	66.5	11.50	14.7

<sup>1</sup>All weights in ounces.  
<sup>2</sup>Mince weight determined by difference.

**Table 7.—Input data and results of inspectors' examination of 5-pound mixed fillet-mince fish blocks, Lot 3, 25 percent mince level.**

Block No.	Input			Insp. no.	Inspector results (Determination 2)			
	Fillet weight <sup>1</sup>	Mince weight <sup>1</sup>	Percent mince		Drained block weight	Fillet weight	Mince weight <sup>2</sup>	Percent mince
61	60.25	20.0	24.9	3	80.25	61.5	18.75	25.5
62	60.0	20.0	25.0	2	81.25	60.5	20.75	25.5
63	60.0	20.0	25.0	1	80.25	62.25	18.0	22.4
64	59.75	20.0	25.1	2	81.50	61.25	20.25	24.2
65	60.0	20.0	25.0	3	80.25	58.0	22.25	27.7
66	60.0	20.0	25.0	2	81.75	61.50	20.25	24.8
67	60.0	20.0	25.0	2	82.50	61.50	21.0	25.5
68	60.0	20.25	25.2	1	81.25	62.75	18.50	22.8
69	59.75	20.25	25.3	1	81.0	60.25	20.75	25.6
70	60.0	20.0	25.0	1	81.0	62.50	18.50	22.8
71	60.0	20.0	25.0	3	81.25	60.25	21.0	25.8
72	60.0	20.0	25.0	1	79.25	60.75	18.50	23.3
73	60.0	20.0	25.0	2	81.50	61.0	20.50	25.2
74	60.0	20.0	25.0	2	80.75	61.25	19.50	24.1
75	60.0	20.0	25.0	2	80.25	60.50	19.75	24.6
76	60.0	20.0	25.0	1	81.25	62.75	18.50	22.8
77	60.0	20.0	25.0	2	80.0	58.25	21.75	27.2
78	60.0	20.0	25.0	3	78.25	59.75	18.50	23.6
79	60.0	20.25	25.2	1	78.50	58.5	19.75	25.5
80	60.0	20.0	25.0	2	80.0	59.25	20.75	25.9
81	60.25	20.0	24.9	3	78.25	58.75	19.50	24.9
82	60.0	20.0	25.0	3	79.75	60.75	19.0	23.8
83	60.25	20.0	24.9	3	79.0	58.50	20.50	25.9
84	60.0	20.0	25.0	3	81.25	60.25	21.0	25.8
85	60.0	20.25	25.2	1	78.75	56.0	22.75	28.9
86	60.0	20.0	25.0	1	81.25	61.0	20.25	24.9
87	60.0	20.0	25.0	3	81.0	59.0	22.0	27.2
88	60.25	20.0	24.9	2	84.0	64.25	19.75	23.5
89	60.25	19.75	24.7	1	81.25	59.5	21.75	26.7
90	60.0	19.75	24.8	3	81.75	62.0	19.75	24.2

<sup>1</sup>All weights in ounces.  
<sup>2</sup>Mince weight determined by difference.

**Table 6.—Input data and results of inspectors' examination of 5-pound mixed fillet-mince fish blocks, Lot 2, 20 percent mince level.**

Block No.	Input			Insp. no.	Inspector results (Determination 2)			
	Fillet weight <sup>1</sup>	Mince weight <sup>1</sup>	Percent mince		Drained block weight	Fillet weight	Mince weight <sup>2</sup>	Percent mince
31	63.50	16.0	20.1	3	79.0	63.0	16.0	20.3
32	64.0	16.0	20.0	3	78.75	62.75	16.0	20.3
33	64.0	16.0	20.0	3	80.25	64.25	16.0	19.9
34	64.25	16.25	20.2	2	82.50	64.25	18.25	22.1
35	64.0	16.0	20.0	3	81.75	62.50	19.25	23.5
36	64.0	16.0	20.0	1	80.0	64.0	16.0	20.0
37	64.0	16.0	20.0	2	82.25	64.5	17.75	21.6
38	64.0	16.0	20.0	2	82.0	64.25	17.75	21.6
39	64.0	16.0	20.0	2	84.0	65.5	18.50	22.0
40	64.0	16.0	20.0	3	82.0	63.75	18.25	22.6
41	64.25	16.0	19.9	3	81.75	66.75	15.0	18.3
42	64.0	16.0	20.0	1	80.75	65.0	15.75	19.5
43	64.25	16.0	19.9	1	82.0	66.75	15.25	18.6
44	64.25	16.0	19.9	1	80.25	64.25	16.0	19.9
45	64.0	16.0	20.0	1	81.75	62.75	19.0	23.2
46	64.0	16.0	20.0	1	80.0	63.0	17.0	21.3
47	64.0	16.0	20.0	3	80.75	64.75	16.0	19.8
48	64.0	16.0	20.0	1	82.0	66.0	16.0	19.5
49	64.0	16.0	20.0	1	79.50	66.25	13.25	16.7
50	64.25	16.0	19.9	2	81.0	66.50	14.50	17.9
51	64.0	16.0	20.0	2	81.50	65.25	16.25	19.9
52	64.0	16.25	20.2	2	82.50	65.50	17.0	20.6
53	64.0	16.0	20.0	1	81.25	64.75	16.50	20.3
54	64.0	16.25	20.2	1	83.0	66.50	16.50	19.9
55	63.75	16.0	20.1	2	81.50	65.25	16.25	19.9
56	64.25	16.25	20.2	2	83.75	64.75	19.0	22.7
57	64.0	16.0	20.0	3	79.75	62.75	17.0	20.8
58	64.0	16.0	20.0	3	82.0	63.50	18.5	22.6
59	64.0	16.0	20.0	3	80.50	63.0	17.5	21.7
60	64.0	16.0	20.0	2	83.25	64.0	19.25	23.1

<sup>1</sup>All weights in ounces.  
<sup>2</sup>Mince weight determined by difference.

fish of 15, 20, and 25 percent) by three inspectors.

The results indicate that the method is accurate within a practical range of ± 1.1 percent and that the agreement among inspectors was very high. The level of minced fish, within the range tested of 15-25 percent, had no appreciable effect on the accuracy of the test results or the uniformity of recovery of minced fish among the three inspectors.

Based on these findings, our future work will use commercial size (16.5-pound) fish blocks. The blocks will be hand-made in the laboratory and contain a known level of minced fish. These blocks will be examined by several collaborators using their own facilities and the method modified as agreed to by the methods committee of the technical working group on fish blocks.

**Literature Cited**

Lane, J. P., and T. J. Conners. 1984. Evaluation of methods to determine the proportions of fillets and minced fish flesh in mixed fish blocks. *Mar. Fish. Rev.* 46(2):36-39.