COMPOSITION OF COMMERCIALLY-IMPORTANT FISH FROM NEW ENGLAND WATERS

Part 1 - Proximate Analyses of Cod, Haddock, Atlantic Ocean Perch, Butterfish, and Mackerel

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INTRODUCTION

In recent communications, Stansby (1954) and Love (1957) pointed out the difficulties in interpreting data on the composition of fish and the need for more systematic studies in this field. The review by Love (1957) gives numerous references to published data on the protein, oil, ash, and moisture contents of fishery products. Examination of this literature reveals, however, that much of the data was obtained from the analyses of samples of unrecorded origin and that little information is supplied as to the size, sex, season, or area-of-catch of the samples analyzed. It is known that the composition of fish varies from species to species and often to an even greater extent from one individual fish to another of the same species (Bogucki and Trzesinski 1950; Ventkataraman and Chari 1951); yet few investigators have taken into account the factors that contribute to these variations.

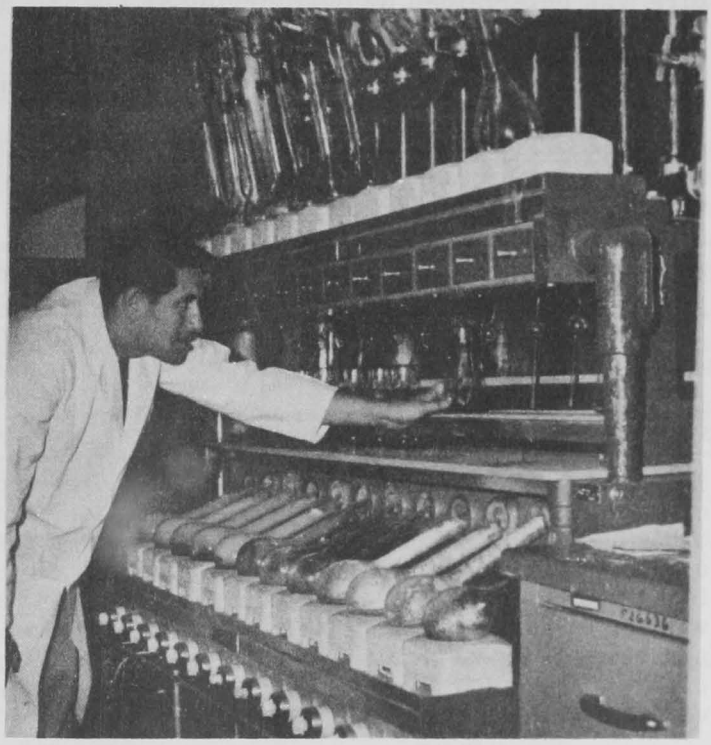

Fig. 1 - Kjeldahl determination of protein.

Since proximate components vary within a wide range, an average value of a proximate component for any species has little meaning without the establishment of at least the approximate limits of the range of composition values. The correlation of ranges of value with the factors that determine the composition is also of importance.

Because information on composition is inadequate, we are engaged in a study to collect more representative data. Factors under consideration in our determinations of composition include species of fish, season, and geographic area where the fish were captured.

This report is concerned with the quantitative differences in the composition components that occur among species of fish taken from New England waters. Data also are presented on the ranges of composition that occur within certain species of fish and on the role that seasonal factors play in contributing to variability of composition. The protein, oil, ash, and moisture contents of the edible fillets and of the offal[1]/ of some commercially-important species of New England fish are reported. Subsequent reports will be issued as the study

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1/ Offal is the entire body of the fish minus the fillet. It includes head, bone, frame, skin, and viscera.

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FISH AND WILDLIFE SERVICE
SEP. NO. 613

progresses, making it possible to determine the degree of variation of the composition of fish of the same species taken in different years from the same geographic areas and during the same seasons.

PROCEDURE

SAMPLING TECHNIQUE: The fish used in this study all were obtained from the "inshore" fishing fleet." Only fish in prime condition were selected; that is, they were well iced and were usually no more than 12 to 14 hours out of the water when analyzed. Samples were selected to give a composite of the commercially-landed catch. Representative samples of all sizes landed were selected. Samples were collected during a period of one year, and care was taken to insure that all samples of a given species were captured in the same general geographic area.

CHEMICAL ANALYSES: Nitrogen was determined by the Association of Official Agricultural Chemists Method (1950), and the factor 6.25 was used to calculate the protein content. Oil was determined by ether extraction in a Goldfisch fat-extraction apparatus. Moisture was determined by oven drying at 110° C. to constant weight, and ash was determined by combustion in a muffle furnace at 550° C.

RESULTS AND DISCUSSION

VARIATIONS IN COMPOSITION AMONG DIFFERENT SPECIES OF FISH: Table 1 presents values for the protein, oil, ash, and moisture content of the fillets of a number of species of New England fish. The ranges of values in the composition components are the ranges

Table 1 - Range of Composition Values of Edible Fillets of Some Species of New England Fish

Species	No. of Fish Analyzed	Protein		Oil		Ash		Moisture	
		Average	Range	Average	Range	Average	Range	Average	Range
		(Percent)							
Cod (Gadus morhua)	48	17.9	16.6-19.2	0.09	0.03-0.1	1.1	0.9-1.4	80.9	79.8-82.4
Haddock (Melanogrammus aeglefinus)	42	18.8	15.5-20.2	0.17	0.05-1.3	1.2	0.9-1.6	79.7	78.2-82.1
Ocean perch (Sebastus marinus)	72	17.9	15.3-19.4	1.1	0.2-4.1	1.1	0.9-1.8	79.3	75.9-84.4
Butterfish (Poronotus triacanthus)	14	16.9	16.8-18.2	11.4	7.6-22.2	1.1	0.8-1.7	70.6	64.8-74.5
Mackerel (Scomber scombrus)	26	17.3	13.9-19.4	21.0	10.4-28.7	1.3	0.8-2.2	60.0	53.7-68.4

that we have observed in our laboratory over a period of one year. All of the components of composition exhibit a range of values, but the component showing the greatest variability is oil. The species in table 1 may be arbitrarily divided into two groups according to their oil content. Cod, haddock, and ocean perch, which are species with oil content ranging from less than 0.1 to 4.1 percent, may be classified as lean fish whereas butterfish and mackerel, with oil contents ranging from 7.6 to 28.7 percent, may be classified as oily fish. Moisture and protein also exhibit variation among species. On an absolute basis, ash content is rather constant, varying only between 0.8 and 2.2 percent. On a percentage basis, however, this variation is very large.

VARIATIONS IN COMPOSITION AMONG FISH OF THE SAME SPECIES: Table 2 presents data on the variation in composition of mackerel fillets. Samples 1 to 6, which were landed during the month of October, show a narrow range of values for any one component; whereas 7 through 12, which were landed during the month of November, show a generally wide range of values. The oil and moisture components exhibit the greatest variation, whereas the protein component exhibits little variation. The mackerel are pelagic fish, and the variation in the fat component may be influenced by the migratory habits of this species (Stansby and Lemon 1941). These data indicate the wide range of values with re-

Table 2 - Composition of Edible Fillets of Mackerel (Scomber scombrus) Caught During Fall of Year

Date Captured	Fish No.	Fillet Composition			
		Protein	Oil	Ash	Moisture
		(Percent)			
October	1	17.9	23.0	1.7	57.1
	2	17.8	23.8	1.6	56.2
	3	18.5	22.3	1.2	57.3
	4	18.3	22.7	1.4	57.5
	5	18.3	22.5	1.1	57.4
	6	17.7	24.2	1.3	56.8
November	7	19.4	10.4	1.8	68.4
	8	18.8	11.6	1.8	67.7
	9	18.5	14.0	1.9	65.8
	10	19.1	14.6	2.0	64.2
	11	18.3	18.8	2.4	60.5
	12	18.2	20.3	2.2	59.4

Table 3 - Proximate Composition of Fillets and Offal of Cod (Gadus morhua)

Season Captured	No. of Samples	Fillet Composition								Offal Composition							
		Protein (**)		Oil (**)		Ash (**)		Moisture (**)		Protein (**)		Oil (**)		Ash (**)		Moisture (**)	
		Av.	Range	Av.	Range	Av.	Range	Av.	Range	Av.	Range	Av.	Range	Av.	Range	Av.	Range
		(Percent)															
Spring	24	18.0	16.6-19.2	.09	.03-0.2	1.2	1.0-1.4	81.4	79.8-82.4	16.1	15.0-17.5	0.7	0.3-2.2	4.4	3.0-6.6	78.3	76.2-79.8
Summer	12	17.4	16.6-18.4	.11	.03-0.2	1.0	0.9-1.1	81.5	80.4-82.4	1/	1/	1/	1/	1/	1/	1/	1/
Fall	12	18.1	17.8-18.4	.08	.06-.11	1.0	0.9-1.1	80.6	80.1-81.0	15.9	14.3-16.7	4.3	3.4-4.8	3.4	2.9-4.4	76.3	74.9-78.5
Winter	12	17.7	16.3-18.7	0.05	.03-.07	1.1	1.1-1.3	80.9	80.4-82.1	16.8	15.6-18.1	0.3	0.1-0.6	4.6	3.4-6.9	78.5	77.3-80.5

1/ These cod were received in the "gutted" condition.
**Variation related to the season at the 5-percent level of significance.

Table 4 - Proximate Composition of Fillets and Offal of Ocean Perch (Sebastes marinus)

Season Captured	No. of Samples	Fillet Composition								Offal Composition							
		Protein (***)		Oil (***)		Ash (***)		Moisture (***)		Protein (**)		Oil (***)		Ash (-)		Moisture (***)	
		Av.	Range	Av.	Range	Av.	Range	Av.	Range	Av.	Range	Av.	Range	Av.	Range	Av.	Range
		(Percent)															
Spring	36	18.1	17.0-19.4	1.4	0.2-4.1	1.1	1.0-1.8	79.3	75.9-82.0	16.2	14.9-17.9	8.5	1.0-12.9	6.7	4.8-9.3	68.3	62.8-78.4
Summer	12	18.1	17.3-18.5	1.1	0.3-1.9	1/	1/	78.8	77.4-80.4	15.9	15.0-17.9	4.0	2.3-7.2	6.3	4.4-8.7	73.6	66.2-77.9
Fall	24	17.6	15.3-19.0	0.6	0.2-1.1	1.1	1.0-1.7	80.3	78.4-84.4	16.1	15.1-17.2	6.4	4.8-8.0	6.4	6.0-8.0	70.5	69.0-72.5
Winter	12	18.1	17.3-19.1	1.3	0.4-2.8	1.1	0.9-1.4	78.9	76.8-80.8	17.0	16.0-19.0	8.4	5.7-11.5	6.7	6.0-8.3	67.4	63.0-71.1

1/ Sample was lost.
(-) Variation is not related to the season.
(**) Variation related to the season at the 5-percent level of significance.
(***) Variation related to the season at the 1-percent level of significance.

Table 5 - Proximate Composition of Fillets1/ and Offal of Mackerel (Scomber scombrus)

Season Captured	No. of Samples	Fillet Composition								Offal Composition							
		Protein (***)		Oil (**)		Ash (***)		Moisture (***)		Protein (***)		Oil (***)		Ash (-)		Moisture (***)	
		Av.	Range	Av.	Range	Av.	Range	Av.	Range	Av.	Range	Av.	Range	Av.	Range	Av.	Range
		(Percent)															
June	6	15.1	13.9-16.2	21.5	18.6-23.5	1.0	0.8-1.1	61.9	60.3-64.0	13.3	12.9-13.6	18.1	17.2-19.2	3.1	2.7-3.4	65.1	65.0-65.5
October	6	18.1	16.4-18.5	23.1	19.3-28.7	1.4	0.9-1.7	57.0	56.2-57.5	15.0	14.2-16.2	19.4	16.0-20.2	3.6	2.9-4.1	61.6	60.1-67.3
November	6	18.7	18.2-19.4	14.9	10.4-20.3	2.0	1.1-2.2	64.3	59.4-68.4	15.7	14.1-16.4	15.5	13.5-17.4	3.9	3.1-4.4	65.2	63.0-67.4

1/ These fillets were analyzed with the skins on, since this is the way they usually are prepared.
(-) Variation is not related to the season.
(**) Variation related to the season at the 5-percent level of significance.
(***) Variation related to the season at the 1-percent level of significance.

spect to some components that may occur in fish of the same species captured during different times of the same season.

VARIATIONS IN COMPOSITION OF FISH HARVESTED DURING DIFFERENT SEASONS OF THE YEAR: The seasonal variation in the composition components of cod, ocean perch, and mackerel are shown in tables 3, 4, and 5. Analyses of variance (F-test 2/) was used to determine if there were statistically-significant differences in the protein, oil, ash, and moisture contents of the fillets, and of the offal owing to the season in which the fish were caught. In the case of cod (table 3), all of these components were found to be statistically significant at the 5-percent level for season.

Table 4 indicates that seasonal variations of all the proximate components of the fillets and offal of ocean perch, except for ash of the offal, are statistically significant at the 1-percent level. No significant relation was found between the variation of the ash content of the offal and the season.

The data for mackerel are not extensive enough to permit analysis for variation due to season. They have been examined to determine the relation between variation in composition and the 3 months for which data were collected. Table 5 indicates that monthly variations of protein, ash, and moisture contents of mackerel fillets are statistically significant at a level greater than 1-percent. The variation in oil values of the fillets is related to the month at the 1-percent level of significance. The monthly variations for protein, oil, and moisture of mackerel offal are related to the month at a level greater than 1 percent. There is no significant relationship between variation in the ash content of the offal and the time of the year.

SUMMARY

The protein, oil, and moisture contents of cod, haddock, Atlantic ocean perch, butterfish, and mackerel were determined.

Application of the F-test for analyses of variance indicated that in almost all cases, the variation in proximate components that exists within a species is related to the time of the year. The degree of significance of this relationship is greater for ocean perch and mackerel than it is for cod.

2/The F-test is a statistical test permitting the evaluation of real, existing, and/or nonexisting differences between and among variables.

Note: The authors gratefully acknowledge the contribution of Mrs. Sue Nealis, Statistical Assistant, U. S. Bureau of Commercial Fisheries Technological Laboratory, College Park, Md., in performing the analyses of variance.

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