PROXIMATE COMPOSITION OF GULF OF MEXICO INDUSTRIAL FISH

Part 3 - Fall Studies (1958)

By Mary H. Thompson*

ABSTRACT

The protein, oil, ash, and moisture content of limited samples of 17 species of industrial fish commonly taken during the fall in the Gulf of Mexico area are reported. Included also are length and weight data for those same species. The method of sampling is evaluated.

INTRODUCTION

Studies started in the winter of 1958 on the proximate composition of Gulf of Mexico industrial fish have been continued to include the fall months. The project was undertaken to provide more complete information for use by industrial fisheries on the protein, oil, ash, and moisture content of 17 representative species of industrial fish found in the area. Length and weight data have also been obtained.

Fig. 1 - Shrimp is a valuable byproduct of industrial fishing.

Observations made during the fall months (September, October, and November) point to the necessity for tabulating the data seasonally, as moisture and oil content varies markedly in some species with meteorological conditions. The data should be gathered over a long period of time in order to show the true trends and variations. Since, however, there is an immediate need by industry for this information, an effort has been made to disseminate it as recorded.

SAMPLES

All samples for the fall series have been collected by laboratory personnel from boats landing in the Pascagoula area. These samples had been well iced for 2 to 3 days previous to collection and were in good to excellent condition upon arrival at the laboratory. They were immediately frozen in plastic bags and stored at -20° F. until analyzed.

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PHYSICAL MEASUREMENTS

The frozen fish were thawed, rinsed, and drained before physical measurements were made. The length measurements were of two types. Those species having a well-defined fork tail were measured from the extreme tip of the mouth to the apex of the angle formed by the two sides of the tail. These are referred to in table 3 as "forktail" measurements. Those species having a more or less blunt tail were measured from the extreme end of the mouth to the farthest extension of the tail. These are referred to in table 3 as "overall" measurements. All length measurements are recorded in centimeters.

Weight measurements have been recorded in grams and were obtained by means of a double-beam balance. These figures are also given in table 3.

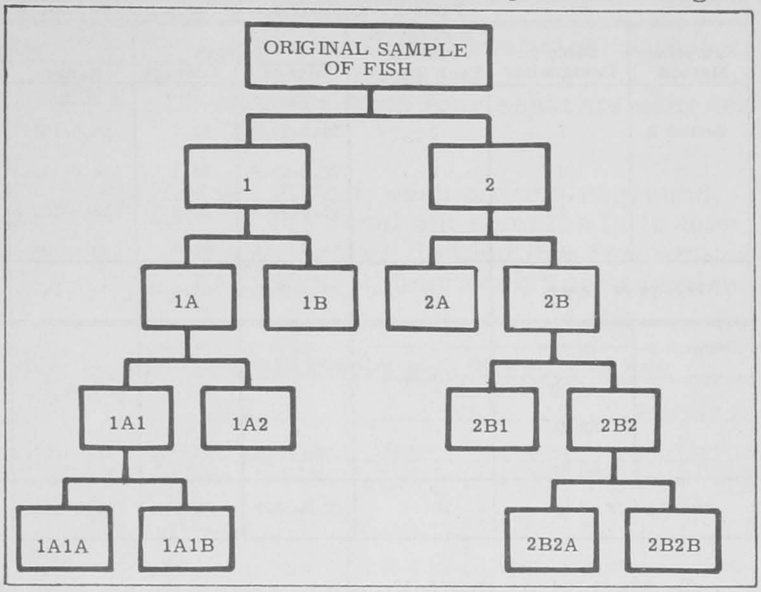

Fig. 2 - Procedure used in method B for obtaining analytical samples. Subsamples 1B, 2A, 1A2, and 2B1 are discarded. Subsamples 1A1A, 1A1B, 2B2A, and 2B2B are taken for analysis.

With the smaller fish (scad and anchovies), a random sample of 20 fish was selected for length and weight measurements as being representative of the whole lot.

Table 1 - Comparison of Sampling Methods A and B--Silver Perch

Sampling Method	Sample Designation	Number of Fish in Each Sample	Length		Weight		Composition of Sample			
			Range	Average	Range	Average	Protein	Oil	Ash	Moisture
			Cm.	Cm.	Grams	Grams	Percent	Percent	Percent	Percent
Method A	1	4	16.3-17.5	16.8	43.5-61.3	51.4	15.9	1.5	3.15	79.1
	2	4	15.5-18.4	16.9	49.9-62.6	54.4	16.9	2.4	5.07	75.6
	3	4	15.9-17.8	17.0	40.0-61.4	51.2	16.4	2.5	4.74	76.2
	4	4	14.8-17.1	16.7	32.3-50.1	50.4	16.5	2.4	4.97	76.6
Average or range		16	14.8-18.4	16.9	32.3-62.6	51.9	16.4	2.2	4.48	76.9
Method B	1A 1A	-	-	-	-	-	16.9	2.8	5.56	75.4
	1A 1B	-	-	-	-	-	16.6	2.7	5.68	74.9
	2B 2A	-	-	-	-	-	16.5	2.8	6.38	75.5
	2B 2B	-	-	-	-	-	16.3	2.7	5.98	75.2
Average or range		15	13.1-17.5	15.8	24.6-55.8	40.0	16.6	2.8	5.72	75.3

PROXIMATE COMPOSITION

The methods of proximate analysis used were described in detail in Part 1 of this series (Thompson 1959).

A study was made during the fall season in an effort to determine the best methods of sampling and grinding the fish. The procedure in use affords a range of values for each species, as the protein, oil, ash, and moisture content tends to vary within the species in any given season. It was necessary to determine whether this was a true range or merely represented variations in sampling techniques. Two series of tests were made: one on silver perch and one on white trout. In each series, two methods of preparation were used: Method A and Method B.

Table 2 - Comparison of Sampling Methods A and B--White Trout

Sampling Method	Sample Designation	Number of Fish in Each Sample	Length		Weight		Composition of Sample			
			Range	Average	Range	Average	Protein	Oil	Ash	Moisture
			Cm.	Cm.	Grams	Grams	Percent	Percent	Percent	Percent
Method A	1	2	21.3-24.0	22.7	105.8-133.3	119.6	17.4	7.4	2.41	72.9
	2	2	22.2-23.9	23.1	132.2-141.1	136.7	17.6	7.3	2.56	72.3
	3	2	21.6-24.2	22.9	115.1-136.6	125.8	17.6	4.6	2.86	74.9
	4	2	19.9-21.4	20.7	90.6-104.7	97.7	18.2	5.3	3.89	72.2
Average or range		8	19.9-24.2	22.4	90.6-141.1	120.0	17.7	6.2	2.93	73.1
Method B	1A 1A	-	-	-	-	-	17.6	6.1	3.91	73.1
	1A 1B	-	-	-	-	-	17.5	6.0	3.42	72.7
	2B 2A	-	-	-	-	-	17.6	5.9	3.30	73.0
	2B 2B	-	-	-	-	-	17.9	6.1	3.91	72.9
Average or range		10	20.3-23.7	21.9	93.2-124.7	110.0	17.7	6.0	3.64	72.9

In Method A, the following procedure was employed:

1. Select at random a large lot of fish from an incoming fishing vessel.

2. From the lot, take sufficient silver perch or white trout to make a sample with an aggregate weight of at least 150 to 200 grams.

Table 3 - Location of Catch and Physical Measurements of Industrial Fish Commonly Obtained in the Fall

Name		Date 1958	Location	Total Number of Fish Analyzed	Type of Measurement	Length		Weight	
Common	Scientific					Range	Average	Range	Average
						Cm.	Cm.	Grams	Grams
Anchovies....	Anchoa hepsetus	Oct.	Horn Is.	40	Forktail	10.4-12.7	11.5	10.6-20.4	13.7
Bumper	Chloroscombrus chrysurus	Sept.	Gulf Shores	8	Forktail	16.6-29.9	19.2	65.6-97.2	80.3
Butterfish....	Poronotus triacanthus	Nov.	Gulf Shores	8	Forktail	8.1-16.0	13.0	16.8-135.6	76.4
Croaker	Micropogon undulatus	Sept.	Gulf Shores	8	Over-all	19.3-21.4	20.7	73.6-110.2	94.7
Croaker, banded	Larimus fasciatus	Nov.	East Gulf	8	Over-all	18.6-20.5	19.5	83.9-124.5	103.1
Grunt.......	Haemulon sp.	Sept.	Gulf Shores	8	Forktail	13.0-19.0	16.0	31.3-121.7	67.1
Hardheads....	Galeichthys felis	Nov.	East Gulf	11	Forktail	14.3-21.8	17.4	40.2-146.7	69.4
Harvestfish1/ .	Peprilis alepidotus	Sept.	Gulf Shores	7	Forktail	14.2-16.7	15.3	57.7-84.2	68.8
Menhaden ...	Brevoortia patronus	Oct.	Pascagoula River	8	Forktail	13.0-18.0	16.3	42.4-122.6	94.8
Razorbellies ..	Harengula pensacolae	Sept.	Gulf Shores	20	Forktail	11.8-14.4	13.0	27.8-51.0	38.6
Round herring .	Etrumeus teres	Nov.	East Gulf	11	Forktail	15.1-21.0	18.4	42.2-106.9	75.3
Scad	Trachurus lathami	Oct.	Horn Is.	24	Forktail	10.9-14.4	11.8	15.1-30.0	19.6
Silver eels ... (Cutlassfish)	Trichiurus lepturus	Sept.	Gulf Shores	4	Over-all	65.0-72.1	67.4	147.1-211.5	179.5
Silver perch Method A ..	Bairdella chrysura	Oct.	Horn Is.	16	Over-all	14.8-18.4	16.9	32.3-62.6	51.9
Silver perch Method B ..	Bairdella chrysura	Oct.	Horn Is.	15	Over-all	13.1-17.5	15.8	24.6-55.8	40.0
Spots	Leiostomus xanthurus	Sept.	Gulf Shores	12	Forktail	14.6-16.2	15.4	44.6-62.8	55.1
Threadfin2/ ..	Polydactylus octonemus	Nov.	Sand Is.	16	Forktail	12.9-16.5	14.6	29.7-73.1	47.7
White trout, Method A ..	Cynoscion sp.	Oct.	Horn Is.	8	Over-all	19.9-24.2	22.4	90.6-141.1	120.0
White trout, Method B ..	Cynoscion sp.	Oct.	Horn Is.	10	Over-all	20.3-23.7	21.9	93.2-124.7	110.0

1/Figures are from 3 samples, instead of the usual 4.
2/Figures are from 5 samples, instead of the usual 4.
Note: Data on the proximate analysis of these fish are found in table 4.

3. Pass the sample through a food grinder (such as a General Food Grinder, Model H) three times.

4. Take a portion of the ground material for an analytical sample.

5. Repeat steps 2, 3, and 4, so as to form three additional analytical samples.

Thus, in Method A, four analytical samples result from four separate samples of fish.

In Method B, the entire lot is ground, divided in half, each portion reground, and half of the latter portions discarded. Each of the resultant samples is in turn reground, half of each discarded, and the remaining halves divided into two samples for analysis, as indicated in figure 2. Thus, in Method B, four analytical samples also result.

Table 4 - Proximate Composition of Limited Samples[1/] of Industrial Fish Commonly Obtained in the Fall

Common Name	Total Number of Fish Analyzed	Protein		Oil		Ash		Moisture	
		Range	Average	Range	Average	Range	Average	Range	Average
		Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Anchovies	40	16.1-16.4	16.2	2.7-3.8	3.1	3.53-3.91	3.69	76.6-78.2	77.2
Bumper	8	18.1-19.2	18.6	4.7-5.4	5.1	3.11-5.13	3.91	70.2-73.4	72.2
Butterfish	8	16.1-16.9	16.6	1.5-3.1	2.6	1.92-2.85	2.37	76.9-80.6	78.5
Croaker	8	16.0-17.1	16.5	2.9-4.2	3.6	2.73-5.29	3.96	74.3-76.9	76.0
Croaker, banded	8	17.5-18.1	17.8	1.5-2.8	2.3	3.08-4.54	4.03	74.2-76.9	75.6
Grunt	8	16.0-17.1	16.6	7.1-11.8	9.9	2.99-4.48	3.71	68.1-72.5	70.2
Hardheads	11	15.4-16.0	15.7	7.9-9.7	8.8	4.23-6.31	5.34	69.1-70.8	69.8
Harvestfish[2/]	7	18.0-18.5	18.3	2.9-4.7	3.6	2.02-2.94	2.60	74.1-75.9	75.1
Menhaden	8	14.7-14.9	14.8	15.1-16.8	16.0	2.79-3.90	3.38	63.9-66.7	65.4
Razorbellies	20	18.1-18.8	18.5	6.2-7.3	6.7	4.80-6.92	5.82	68.5-70.2	69.0
Round herring	11	18.3-19.0	18.7	1.1-4.7	3.0	3.47-3.82	3.72	73.7-77.1	75.3
Scad	24	16.9-17.5	17.3	2.0-2.5	2.2	3.03-4.28	3.55	76.5-77.6	76.9
Silver eels, (Cutlassfish)	4	17.5-18.0	17.8	1.9-3.3	2.7	3.09-4.04	3.51	75.5-77.8	76.4
Silver perch, Method A	16	15.9-16.9	16.4	1.5-2.5	2.2	3.15-5.07	4.48	75.6-79.1	76.9
Silver perch, Method B	15	16.3-16.9	16.6	2.7-2.8	2.8	5.56-6.38	5.72	74.9-75.5	75.3
Spots	12	16.7-17.1	16.9	2.4-4.1	3.5	3.34-4.31	4.00	75.7-77.3	76.7
Threadfin[3/]	16	17.3-18.3	17.8	5.1-8.5	6.8	3.44-4.12	3.73	69.9-72.9	71.7
White trout, Method A	8	17.4-18.2	17.7	4.6-7.4	6.2	2.41-3.89	2.93	72.2-74.9	73.1
White trout, Method B	10	17.5-17.9	17.7	5.9-6.1	6.0	3.30-3.91	3.64	72.7-73.1	72.9

1/The sampling was done by method A, as described under "Proximate Composition." For each species, the data are representative only of the fish of that species landed on one trip by one vessel.
2/Figures are from 3 samples, instead of the usual 4.
3/Figures are from 5 samples, instead of the usual 4.
Note: Data on the physical measurements of these fish are found in Table 3.

Method A produces four different samples and therefore gives a range of values. Method B produces four samples, all of which should give the same values for a check of the grinding and sampling techniques and, in addition, produces two pairs of samples that should give the same values for a check of the analytical procedure.

Since both original samples for Methods A and B came from the same lot of fish, the mean values for both methods should agree. It was found that the mean of Method A in all cases fell within 3 standard deviations from the mean of Method B. Inasmuch as there is the possibility of variation in size and maturity of the fish at any one time, as well as other factors which seem to influence the proximate composition, it was felt that in many instances a range as well as a mean would be desirable. Thus the method giving the range of values (Method A) was chosen in preference to that giving one value for each lot. Tables 1 and 2 show the results of the comparison between these two methods using both silver perch and white trout.

Table 5 - Seasonal Changes in Oil and Moisture Contents--Summer to Fall

Common Name	Change in Oil Content Summer to Fall	Change in Moisture Content Summer to Fall
	. . . . .(Percent)	
Anchovies	+0.5	-0.1
Bumper	-0.9	+0.9
Butterfish	-3.6	+2.5
Croaker	0.0	0.0
Hardheads	+2.1	-1.2
Harvestfish	-3.9	+2.1
Menhaden	-1.8	+2.1
Razorbellies	+1.7	-2.8
Silver eels (Cutlassfish) .	+0.1	-1.5
Spots	-9.4	+8.6
Threadfin	+5.0	-4.9
White trout	+1.2	-1.2

Note: These estimations are based on only a few samples. Although the estimates represent the best presently available knowledge, further studies may change them.

Results of the present analysis are given in tables 3 and 4. In these tables, the total number of fish used may be divided by four to provide the approximate size of each subsample.

Table 5 indicates the seasonal changes in oil and moisture content of several species. Changes in protein and ash content are small; generally, the ranges overlap from one season to the next. These changes therefore are not presented.

For evaluation of trends, it is advisable to have a large number of samples over a period of years (Stansby 1954). Accordingly, the data accumulated are being presented without discussion in an effort to bring this information before the industry as soon as possible. Parts 1 and 2 of this series (Thompson 1959) together with the present part 3, provide proximate analysis information for some species on a four-season basis, yet the entire picture of fluctuations is not definitive. It will be necessary to obtain more samples to attain any degree of completeness.

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TECHNICAL NOTE NO. 54 - DICARBONYL COMPOUNDS AS COMPONENTS OF FISH ODOR

ABSTRACT

The presence of dicarbonyl and α-hydroxy carbonyl compounds of four carbon atoms or less, are indicated in 2,4-dinitrophenylhydrazine derivatives of mixed carbonyl compounds prepared from fresh and from frozen haddock. These compounds may be important odor and flavor components and possibly could be used as the basis for objective quality tests for fishery products.

INTRODUCTION

It has long been known that dicarbonyl compounds are important contributors to the flavor and odor of foodstuffs. Previous investigators have reported that diacetyl is partially responsible for the flavor and odor of butter and bread (Van Niel, Kluyver, and Dirx 1929; Hooft, Visser, and DeLeeuw 1935). Keeney (1957) reported the isolation of unknown α, B-dicarbonyl compounds from heated milk; and Underwood, Lerito, and Willets (1956) reported the isolation of a number of α-dicarbonyl compounds from maple syrup. Lundberg (1957) and Privett, Chipault, Schlenk, and Lundberg (1958) reported that the odor and flavor components of oxidized fish oils consist largely of unsaturated carbonyl and dicarbonyl compounds. Sinnhuber and Yu (1958) have suggested that malonaldehyde is the carbonyl compound active in the thiobarbituric acid (TBA) test for oxidative rancidity in fishery products. They refer to the work of Patton and Kurtz (1951) who concluded that malonaldehyde was the compound responsible for the red color developed with TBA reagent in oxidized milk fat.

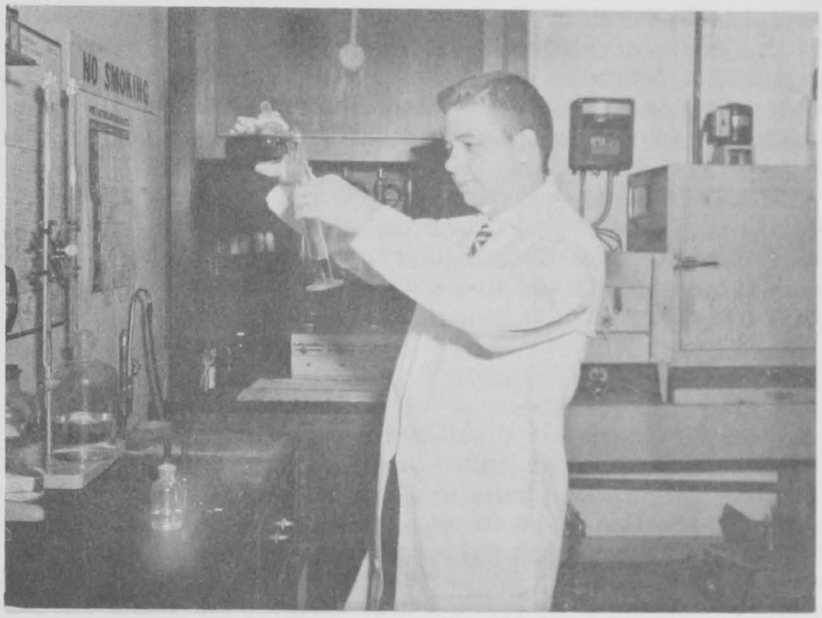

Fig. 1 - The preparation of derivatives from frozen haddock fillets.

The preparation of derivatives of dicarbonyl compounds from the neutral volatile distillate of haddock fillets are reported in this note.

PROCEDURE

The samples used in these experiments were skinless haddock fillets obtained either from fish that had been out of the water less than 24 hours or from fish that had been frozen and stored for 3 months at 14° F. (-10° C.) and then thawed in air at room temperature for 8 hours. The neutral volatile distillate, which exhibited a characteristic fish odor, was obtained by distilling a 1,500-gram sample of finely chopped fillet at room temperature under a vacuum of less than 1 micron (mercury) pressure. The volatile distillate was collected by condensation in a receiver immersed in liquid nitrogen.

The 2,4-dinitrophenylhydrazine derivatives of the carbonyl compounds present in the distillate were prepared by the method of Neuberg, Grauer, and Pisha (1952).

Fifty milliliters of a 60-percent perchloric acid solution containing 1.2 grams of 2,4-dinitrophenylhydrazine were added to 50 milliliters of the neutral volatile distillate. This reaction mixture was allowed to stand at room temperature for 24 hours. The resulting precipitate was centrifuged, washed with 30-percent perchloric acid and distilled water, and then oven dried at 122° F. (fig. 1).

RESULTS

The 2,4-dinitrophenylhydrazine derivatives were obtained from samples of both fresh and frozen haddock fillets. Although exact quantitative data were not obtained, the yield of 2,4-dinitrophenylhydrazine derivatives from the frozen samples was considerably greater than the yield from the fresh samples. A melting point determination gave little information except to indicate that the precipitate was not a pure compound. The melting point was indefinite, and decomposition of the derivative occurred. The derivatives were insoluble in ethanol and methanol, partially soluble in benzene and dioxane, but soluble in sodium ethylate. In sodium ethylate the derivatives formed a deep violet color, which is characteristic of dicarbonyl and α-hydroxy compounds (Neuberg and Strauss 1945). Infrared spectra indicated that the compounds were probably aliphatic in nature and that the greater percentage of the compounds contained four or less carbon atoms.

Dicarbonyl or α-hydroxy carbonyl compounds may prove to be important components of the odors of other fishery products such as fish oil and fish meal. It is also suggested that the production of the violet color by the 2,4-dinitrophenylhydrazine derivatives in sodium ethylate may serve as the basis for an objective quality test for fishery products.

SUMMARY

A neutral volatile distillate from fresh and frozen stored skinless haddock fillets was condensed at liquid nitrogen temperature by distillation at room temperature. A 2,4-dinitrophenylhydrazine solution was added to the distillate, and a precipitate was allowed to form for 24 hours at room temperature. The precipitate was then centrifuged, washed with 30-percent perchloric acid and distilled water, and then dried. No quantitative data were obtained on the amount of derivative formed; however, the frozen fish yielded a greater amount of derivative than did the fresh fish. The melting range of the derivative was large (indicating a mixture, not a pure compound) and decomposition occurred.

Color reaction in sodium ethylate, solubility data, and infrared spectra indicated that the derivatives had been formed from dicarbonyl and α-hydroxy carbon compounds of four or less carbon atoms. The carbonyl compounds may prove to be important components of the flavors and odors in fishery products, and a test for these compounds may serve as objective quality indexes in fishery products.

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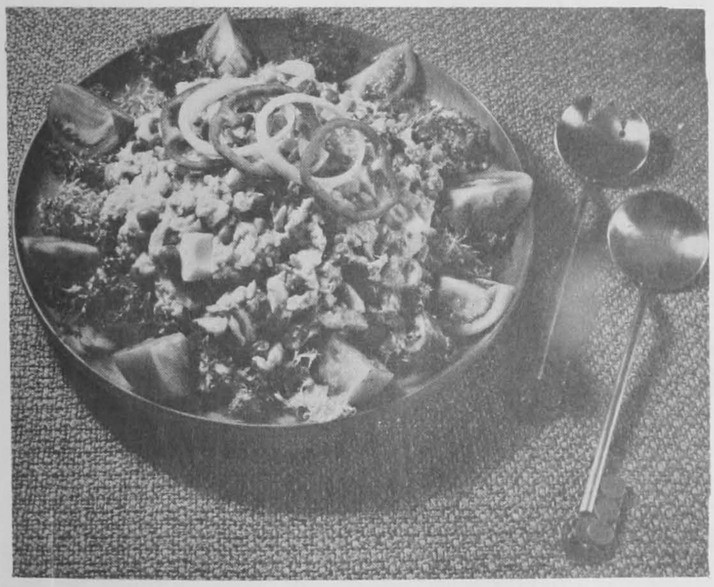
SALMON SALAD

The new season's stock of canned salmon becomes available to the consumer towards the latter part of August. There are five separate and distinct species of salmon that comprise the bulk of the salmon canned in the United States. They are the king, sockeye, silver, pink, and chum. These are all found in the waters of the Pacific extending from Alaska to California.



Almost everyone enjoys the characteristic rich flavor of salmon. The meat is fine in texture, yet firm and moist. The protein content is substantial in quantity and excellent in quality. Salmon contains the important mineral elements calcium, phosphorous, and iodine; and has generous quantities of vitamins A and D, thiamine, and riboflavin.

Each of these species of salmon is equally nutritious, the difference being in the color and oil content of the meat and these differences account largely for the range in price. Thus the budgetwise homemaker is enabled to buy according to her specific needs.

The home economists of the U. S. Fish and Wildlife Service suggest "Salmon Salad."

SALMON SALAD

- 1 1 CAN (16 OUNCES) SALMON
- ½ CUP MAYONNAISE OR SALAD DRESSING
- 1 CUP CHOPPED CELERY
- 2 TABLESPOONS CHOPPED SWEET PICKLE
- 2 TABLESPOONS CHOPPED ONION
- 2 HARD-COOKED EGGS, CHOPPED
- LETTUCE
- 1 HARD-COOKED EGG, SLICED

Drain salmon. Break into large piece. Combine all ingredients except lettuce and egg. Serve on lettuce; garnish with egg slices. Serves 6.