

LOAN COPY ONLY

CIRCULATING COPY
Sea Grant Depository

Institute of Marine Resources
Department of Food Science & Technology
University of California
Davis, California

LOAN COPY ONLY

Lipid Composition of Fish Protein Concentrate

First Quarterly Report
July 1, 1971 - Sept. 30, 1971

Contract No. USDC 1-36062 NOAA
U. S. Department of Commerce

Institute of Marine Resources No. 72-4

BY:

H. S. Olcott
V. J. Smith
Institute of Marine Resources
University of California
Davis, California 95616

Olcott; R/F-1

Gas chromatographic analyses of the methyl esters of the fatty acids from stored and non-stored menhaden FPC samples (lot numbers 67-301, 68-402, and 69-404) are shown in Tables I and II. The 1971 third quarterly and annual reports included some preliminary data.

Storage caused major decreases in the percentages of C20:5 and C22:6 fatty acids and corresponding apparent increases in the percentages of the lower molecular weight fatty acids.

Gulf menhaden FPC M68 contained 1.19% lipid, compared to 0.12% in M69 and 0.14% in M67. The C20:5 and C22:6 fatty acid contents of M68 were 69.3% and 78.4%, respectively, lower than those in M69. One possible explanation is that some oxidation of these fatty acids occurred during the processing of the M68 FPC. The more probable explanation is that the differences represent a fractionation of components, the more unsaturated being the more refractory to extraction by IPA.

The decrease in the percentages of C20:5 and C22:6 fatty acids were greater after storage at 50°C than after storage at 37°C (Tables I and II), as might be predicted if these acids were oxidized during the storage periods.

The loss in C20:5 fatty acid content was greater than that in C22:6 fatty acid content in M67 and M69, as shown in Table II. The situation was reversed in M68. The significance of these differences is not apparent.

The differences observed in column chromatography of the lipids extracted from M68 and those extracted from M67 and M69 meals were described in the 1971 third quarterly and annual reports.

Analyses are being continued on the hake samples (lot number 78-103) stored at three temperatures and two relative humidities. The samples were stored at -18°C in our laboratory. Results to date are shown in Tables III through V.

Two procedures for determining moisture content (volatile matter) were compared; 30-45 hours at 110-115° and 1 hour at 130°. In both procedures, any caking of the meal was broken with a stirring rod and meal adhering to the rod was brushed back into the glass-stoppered weighing bottle in which the sample was dried and weighed. Results from the two methods (Table III) were in close agreement, and the shorter standard A.O.A.C. method^{1/} (with the modification of stirring, as described) is now used in this laboratory.

The percentages of volatile matter in the hake samples stored at different temperatures and humidities are shown in Table IV. Except for the samples stored at 110°F and 50% R.H., there was an apparent increase in the amount of volatile matter with increased storage time. Since % total lipid in the extract is calculated on a dry basis, this variation in moisture content has to be taken into account.

Analyses to date of the lipids extracted are shown in Table V. Results reported in the latest annual report (June 30, 1971) are shown for the sake of comparison.

TABLE I. Effect of Storage on Apparent Fatty Acid Composition of Menhaden FPC.

Fatty Acids ^{a/} conditions	M-67 ^{b/}			M-68 ^{c/}			M-69 ^{d/}		
	fresh	6mo. 37 ^o	6mo. 50 ^o	fresh	6mo. 37 ^o	6mo. 50 ^o	fresh	6mo. 37 ^o	6mo. 50 ^o
14:0	8.43	9.48	9.08	10.46	11.85	14.20	9.92	10.36	10.63
16:0	28.95	30.51	32.49	28.29	26.47	30.62	20.80	29.75	31.01
16:1	8.58	8.92	8.75	14.37	16.16	16.72	13.93	11.36	11.45
18:0	6.48	7.21	7.68	10.07	9.33	8.34	8.13	7.41	7.61
18:1	14.49	15.61	16.15	20.39	20.09	18.18	13.84	11.79	12.20
20:5	7.57	5.41	5.19	2.79	2.22	1.64	9.10	7.27	6.65
22:6	<u>11.33</u>	<u>8.19</u>	<u>7.93</u>	<u>2.17</u>	<u>1.49</u>	<u>1.04</u>	<u>10.04</u>	<u>9.13</u>	<u>7.75</u>
Total ^{e/}	85.83	85.33	87.27	88.54	87.61	90.74	85.76	87.07	87.30

(a) No. of carbon atoms:No. of double bonds.

(b) Atlantic menhaden, lot no. 67-301; total lipid, 0.14%.

(c) Gulf menhaden, lot no. 68-402; total lipid, 1.19%.

(d) Gulf menhaden, lot no. 69-404, total lipid, 0.12%.

(e) Weight percentages ^{2,3} were calculated on the basis of 27 separate components. Only the major ones are shown in the table.

TABLE II. Decrease of C20:5 and C22:6 Fatty Acids with Storage of Menhaden FPC.^(a)

<u>FPC</u>	<u>Fatty Acid</u>	<u>% Decrease</u>	
		<u>6 mo. 37°C</u>	<u>6 mo. 50°C</u>
M-67	C20:5	28.53	33.44
	C22:6	27.71	30.00
M-68	C20:5	20.43	41.22
	C22:6	31.34	52.07
M-69	C20:5	20.11	26.92
	C22:6	9.06	22.81

(a) See footnotes to Table I.

TABLE III. Comparison of Drying Conditions for Determining Percent Volatile Material in FPC Meal.

<u>Sample</u>	<u>Loss in Weight</u> 30-45 hours 110-115°C <u>%</u>	<u>Loss in Weight</u> 1 hour ^(a) 130°C <u>%</u>
6-90-50 ^(b)	8.85	8.75
6-70-90 ^(c)	11.53	11.48

(a) A.O.A.C. method 14.004^{1/}, with the following modification: the drying was interrupted after 30 min. to eliminate lumps or caking by stirring with a glass rod, any meal adhering to the rod was brushed back into the weighing bottle, and drying was continued at 130°C for 30 min.

(b) Meal had been stored for 6 months at 90°F and 50% R.H.

(c) Meal had been stored for 6 months at 70°F and 90% R.H.

TABLE IV. Total Volatile Matter from Hake FPC (78-103) Stored at Different Temperatures and Humidities.

<u>Sample</u>	<u>% Volatile Matter</u>
<u>A. Controls</u> (a)	
0	5.00 5.10 5.20 (b) (c)
1	5.44
3	5.21
6	5.24 5.34 (c)
<u>B. Stored Samples</u> (d)	
1-70-50	7.50 7.72
3-70-50	7.84
6-70-50	8.10 8.18 (c)
1-70-90	10.46 10.50
3-70-90	10.70
6-70-90	11.48 (c) 11.46 (c) 11.53
1-90-50	7.78
3-90-50	8.10
6-90-50	8.75 (c) 8.70 (c) 8.85

Continued on next page...

TABLE IV...continued.

<u>B. Stored Samples</u> ^(d)	<u>% Volatile Matter</u>
1-90-90	12.89
	12.61
	12.92
3-90-90	13.15
	13.02
6-90-90	14.15
	14.20 (c)
1-110-50	7.83
	8.00
	7.74
	7.98 (b) (c)
3-110-50	8.09
	7.96
6-110-50	7.80
	7.98 (c)
1-110-90	12.53
	12.50 (b) (c)
3-110-90	12.35
6-110-90	13.60 (c)
	13.43 (c)

-
- (a) Months of storage at College Park.
 - (b) This value was measured 2-3 months later than the other values for the same storage conditions. The FPC was kept in plastic bags at -18°C in our laboratory.
 - (c) A slight modification of the A.O.A.C. method 14.004 was used, as described in the text.
 - (d) Hyphens separate months of storage, storage temperature in $^{\circ}\text{F}$, and % relative humidity during storage.

TABLE V. Analyses of the Lipids Extracted from Hake FPC stored at Different Temperatures and Humidities.

Sample (a)	Date Extraction Started	Total ^(b) Lipid %	Silic Acid Column Fractions (% of material recovered from column)				
			1	2	3	4	5
0-Control ^(c)	2-2-71	0.08	31.3	11.3	31.7	10.0	15.7
	2-2-71	0.09 [0.09]	25.8 [28.6]	17.7 [14.5]	34.7 [33.2]	8.1 [9.0]	13.8 [14.8]
1-Control	4-5-71	0.10	30.7	13.4	32.1	9.2	14.6
3-Control	5-10-71	0.09	30.3	14.3	26.2	14.1	15.1
1-70-50	2-22-71	0.10	29.7	12.9	32.9	13.5	11.0
3-70-50	5-10-71	0.10	31.6	21.6	22.6	11.8	12.5
1-70-90	3-12-71	0.11	21.7	15.7	36.8	12.4	13.5
3-70-90	5-27-71	0.12	26.9	15.0	39.0	15.0	4.1
1-90-50	2-22-71	0.10	29.7	39.7 ^(d)	--	11.7	18.9
3-90-50	4-22-71	0.10	33.6	16.8	28.0	10.8	10.8
1-90-90	3-12-71	0.11	29.0	10.8	30.4	14.4	15.4
3-90-90	5-27-71	0.12	26.5	11.6	32.2	11.5	18.1
1-110-50	3-12-71	0.10	29.0	12.9	28.7	18.3	11.0
	4-5-71	0.11	40.3 [34.6]	13.6 [13.2]	22.4 [25.6]	10.1 [14.2]	13.6 [12.3]
3-110-50	5-10-71	0.11	30.1	15.3	29.4	14.0	11.2
1-110-90	2-22-71	0.10	28.6	15.6	31.9	10.9	13.0
3-110-90	5-10-71	0.10	26.4	15.0	30.3	13.4	14.9

(a) Hyphens separate number of months of storage (at College Park), storage temperature ($^{\circ}$ F), and % relative humidity during storage.

(b) Based on dry weight of FPC.

(c) The zero-time control sample, rec'd 7-21-70, was not refrigerated during shipment.

(d) Fractions 2 and 3.

[] are averages.

REFERENCES

1. Anonymous in William Horwitz, (Ed.), Official Methods of Analysis of the Association of Official Analytical Chemists, 11th Ed., 1970, p. 211 (14.004).
2. Carroll, K. K., Nature 191,377 (1961).
3. Farquhar, I. W., W. Insull, P. Rosen, W. Stoffel, and E. H. Ahrens. Nutr. Rev. (suppl.) 17, part II, p. 1 (1959).

LOAN COPY ONLY

NATIONAL SEA GRANT DEPOSITORY
PELL LIBRARY BUILDING
URI, NARRAGANSETT BAY CAMPUS
NARRAGANSETT, RI 02882
