NEW ENGLAND FISH MEALS IN THE NATIONAL FISH-MEAL RESEARCH PROGRAM

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BACKGROUND

A nationwide program of research on fish meal and fish oil financed by funds provided under the Saltonstall-Kennedy Act of 1954 was initiated in 1955 by the U.S. Fish and Wildlife Service. The program included studies of composition, nutritional value, and of possible new uses for fish meal and fish oil. The projects were carried out largely by contractors, such as universities and other research organizations. The supervision, liaison, and responsibility for samples were handled by Service personnel.

In order to supply the research contractors with authentic samples of meals and oils, the four Service Fishery Technological Laboratories procured them from the various commercial plants within their own areas. Each was obtained by a staff member who was temporarily stationed at the plant. The bulk of each sample collected was sent to the College Park, Md., laboratory along with all the available data, and these were distributed to the various research contractors.

The role of the East Boston laboratory in the fish meal and oil research program was to collect the various samples of meal and oil from the fish-meal manufacturers in the New England area. The laboratory also arranged for the commercial manufacture of controlled lots of meal. Various samples of meal were also prepared in the laboratory. All samples were analyzed for proximate composition--moisture, protein, fat, and ash content.

SAMPLE PREPARATION

In the New England area, fish meals are made from ocean perch offal, whole menhaden (pogy, mossbunker), whole or broken herring (called sardine, and these materials include the raw and cooked scrap from the canneries), and to a lesser extent, whiting offal and mixed whole "trash" fish. The offal consisted of the waste remaining after filleting and of very small fish. An attempt was made to obtain representative samples of the usual production of each type of meal produced. However, it was impossible to get a representative sample of meal from mixed "trash" fish, since the species composition of the "trash" fish load varied from hour to hour. Fish meal and oil made from ocean perch, menhaden, herring, and whiting were procured from commercial plants in Gloucester, Mass., and Portland and Rockland, Me. Each commercial sample drawn was 100 pounds except sample EBGH-8, ocean perch, which was 2,000 pounds. The raw material was inspected by the staff member of the Service. Where possible, data were also obtained on the location of the catch and the length of time the fish were out of water. The meal sample was taken from the midproduction run on each lot of raw material, so that the first half of the production run would thoroughly clean the equipment of any fish or fish meal of unknown history. All data concerning the history of the samples procured are found in table 1.

All the commercial fish-meal samples, EBGH-1 to EBGH-11, were made by the wet-reduction process, from lots of not less than 50,000 pounds of raw material. The average cooking times ranged from 4 to 5 minutes and the steam pressures employed were from 40 to 50 p.s.i. The cooked material was pressed for an average of 5 minutes in a screw-type press. In samples number EBGH-1, -2, -4, -7, and -8 the press cakes were dried in a continuous hot-air drier whose inlet temperatures ranged from 1400° to 1500° F. Samples EBGH-3, -5, and -6 were dried in a continuous steam-tube dryer at steam pressures of 60 to 100 p.s.i. Before drying samples EBGH-9 (men-

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Table I - Data and Composition of Meal Samples

Description of Meal Sample								Proximate Composition of Meal			
		Raw Material				Preparation of Meal					
Code No.	Sample Size	Species of Fish	Date and Location of Catch	Portions Used	Condition of Raw Material	Scale	Method	Moisture	Protein	Fat	Ash
	Lbs.							(Percent)			
EBGH-1	100	Ocean perch	Gully[1/] 6/24/55		Good	Commercial	Cooked 4 min at 40 p.s.i. steam, pressed 5 min., and hot-air dried. Drying air temp. was 1400°-1500° F	6.3	63.3	11.4	22.4
EBGH-2	100	Ocean perch	Gully[1/] 9/19/55		Fair	Commercial		7.1	58.2	9.0	25.9
EBGH-4	100	Ocean perch	Gully[1/] 4/23/56		Good	Commercial		6.2	58.7	9.5	26.1
EBGH-5	100	Ocean perch	No data on area of catch 6/27/56	Filleted fish frames with viscera	Good	Commercial	Cooked 4 min. at 40 p.s.i. steam, pressed 5 min., and dried in steam jacketed drier. Drying air temp was 212° F.	7.6	61.5	8.2	21.7
EBGH-8	2,000	Ocean perch	Gully[1/] 8/17/56		Good	Commercial	Cooked 4 min at 40 p.s.i. steam, pressed 5 min., and hot-air dried. Drying air temp. was 1400°-1500° F.	5.4	59.2	10.5	23.7
EBGH-11	100	Ocean perch	No data on area of catch 8/24/56		Fair	Commercial	Cooked 4-5 min. at 50 p.s.i. steam, pressed, oil-free press liquor returned to press cake and vacuum-dried. Drying temp. not given	4.9	53.6	11.9	22.3
EBGH-3	100	Herring[3/]	Rockland, Me., area 9/28/55[4/]	Small whole fish	Good	Commercial	Cooked 4-5 min. at 50 p.s.i. steam, pressed 5 min., dried in steam-jacketed drier. Drying air temp. was 212° F.	6.1	62.7	13.0	18.1
EBGH-10	100	Herring[3/]	Portland, Me., area 9/28/56[4/]	Small whole fish and "brokers" fish	Good to Fair	Commercial	Cooked 4-5 min. at 50 p.s.i. steam, pressed 5 min., oil-free press liquor returned to press cake and vacuum dried. Drying air temp. was not given.	8.4	59.1	14.1	16.0
EBGH-6	100	Menhaden	Gloucester, Mass., area 7/2/56[4/]	Whole fish	Good	Commercial	Cooked 4 min. at 40 p.s.i. steam pressed 5 min. and dried in a steam-jacketed drier. Drying air temp. 212° F.	9.4	56.8	20.0	15.4
EBGH-9	100	Menhaden	Portland, Me., area 9/28/56[4/]	Whole fish	Good	Commercial	Cooked 4-5 min. at 50 p.s.i. steam, pressed 5 min., oil-free press liquor returned to press cake and vacuum dried. Drying air temp. not given.	2.0	66.5	13.0	16.1
EBGH-7	100	Whiting	Gloucester, Mass., area 8/10/56[2/]	Filleted fish frames without viscera	Good	Commercial	Cooked 4 min. at 40 p.s.i. pressed 5 min., and hot-air dried. Drying air temp. was 1400°-1500° F.	6.4	65.2	6.0	-
EBA	100	Haddock	Georges Bank 8/54	Filleted fish frames with viscera	Good	Commercial	Cooked 4 min at 40 p.s.i. steam, pressed 5 min., and hot-air dried. Drying air temp. was 14000-1500° F.	7.9	59.3	4.9	26.0
EBB	100	Haddock	Georges Bank 9/54		Good	Commercial	Batch-cooked 6 hrs. at 100 p.s.i. steam, and dried in a steam-jacketed drier. Drying air temp. was 212° F.	7.3	53.3	18.9	20.9
None[5/]	10	Haddock	Georges Pank 5/54 to 12/54	Filleted fish frames without viscera	Good	Laboratory	Oven-dried at 212° F.	2.1	71.2	2.9	23.4
None[5/]	10	Haddock			Good	Laboratory	Boiling solvent-extraction, using ethylene dichloride. Drying temp. was 181° F.	2.1	73.9	0.2	23.1
None[5/]	10	Haddock		Filleted fish frames with viscera	Good	Laboratory	Oven-dried at 212° F.	2.0	53.1	18.6	23.9
None[5/]	10	Haddock			Good		Boiling solvent-extraction, using ethylene dichloride. Drying temp. was 181° F.	4.1	67.6	1.5	27.5

1/GULLY (LIES ABOUT 25 MILES NE OF SABLE ISLAND).
2/THESE FISH WASTES CAME FROM SEVERAL FILLETING PLANTS WHERE NO FIRM DATA ON THE LOCATION AND DATE OF CATCH WAS AVAILABLE.
3/HERRING MEAL IS ALSO CALLED SARDINE BY SOME MEAL MANUFACTURERS.
4/THESE FISH WERE CAUGHT IN THE WATERS WITHIN THE VICINITY OF THE NAMED CITIES.
5/NO CODE DESIGNATION WAS GIVEN TO THESE SAMPLES.

haden), -10 (sardine) and -11 (ocean perch), the oil-free press liquor was returned to the press cake before drying. The press cakes with the added press liquors were then dried in a batch-type steam-tube vacuum drier operated at about 60 p.s.i. steam pressure.

Samples EBA and EBB were special samples made from haddock offal with industrial equipment. A conventional wet-reduction process with a hot-air drier as described in the previous paragraph was used to prepare sample EBA. This meal was made from 15,000 pounds of haddock offal with the viscera left intact, obtained by the laboratory to supply a manufacturer of fishery byproducts.

Sample EBB was made from 10,000 pounds of the same material. This offal was cooked in a batch cooker, known as the dry-reduction process, operated at 100 p.s.i. steam pressure for six hours. After being cooked, this meal was dried in a steam-jacketed drier operated at an average of 90 p.s.i. steam pressure.

Lots of haddock meals of about 10 pounds were prepared in the laboratory from haddock offal from eviscerated fish by oven-drying and by solvent-extraction. The raw material was ground to a slurry in preparation for drying. Oven-dried samples were prepared by drying the slurry at a temperature of 212° F. in circulating air. The solvent-extracted meals were prepared by the following procedure. The ground slurry was mixed into a boiling solvent system of ethylene dichloride, at 181° F., and boiling was continued until almost all the water was removed. The solvent along with the solvent-extracted fat was removed by filtration, and the residual solvent in the meal was removed by heating the meal to 194° F. in circulating air. Additional laboratory-size lots of haddock meals were prepared from the offal of filleted haddock with the viscera left intact, by the oven-drying and by the solvent-extraction methods.

From each lot of meal a representative sample was withdrawn for proximate composition. The results of the analyses are shown in table 1. The bulk of the meal was sealed in polyethylene bags and the bags placed in fiberboard cartons. These cartons were then sent to the Service's College Park laboratory for distribution.

DISCUSSION OF RESULTS

The six ocean-perch meals had an average composition as follows: moisture, 6.2 percent; protein, 59.9 percent; fat, 10.1 percent; and ash, 23.7 percent (on a dry-matter basis: protein, 63.9 percent; fat, 10.8 percent; and ash 25.3 percent). The maximum deviation from the mean protein value was 3.8 percent protein with an average deviation of 2.1 percent protein on a dry basis. The ash content of these ocean-perch meals is high and probably is due to at least two factors. The more important factor for the high ash is the removal of the fillets, which causes an increase in the total ash of the offal. The second factor in increasing the ash content is probably the sand which is found in the viscera of these fish.

Since only two herring meals, two menhaden meals, and only one whiting meal were procured and analyzed, no conclusions or trends can be drawn from these few samples. It will be noted that both the herring and menhaden meals were high in oil content. The oil content of the whiting, as expected, was low and the protein content was high.

Haddock meal samples EBA and EBB reflect the effect of the method of processing the offal. Both samples were made from haddock offal with the viscera included. Sample EBA was made from cooked offal that had been pressed, whereas EBB offal had not been pressed. The unpressed meal was high in fat content, 18.9 percent (20.4 percent on a dry-matter basis), as compared to the fat content of the pressed meal, namely, 4.9 percent (5.4 percent on a dry-matter basis). The protein content shows an inverse relationship to the fat content, namely, 53.3 percent (57.2 percent on a dry-matter basis) for the unpressed meal and 59.3 percent (65.6 percent on a dry-matter basis) for the pressed meal.

The haddock meals prepared in the laboratory from eviscerated haddock offal had very high protein contents. Meal made by drying the ground offal in an oven had a protein content of 71.2 percent (73.0 percent on a dry-matter basis) and a fat content of 2.9 percent (3.0 percent on a dry-matter basis). By processing this offal with the boiling solvent method (using ethylene dichloride) most of the fat, being very soluble in the solvent, was removed by the solvent. As a result, the protein content rose 2.7 percent to a value of 73.9 percent (76.0 percent on a dry-matter basis). Correspondingly, the fat content of the extracted meal went down about 2.7 percent to a value of 0.24 percent (0.25 percent on a dry-matter basis).

Meals made from haddock offal in which the viscera of the fish was left intact showed a lower protein content and a higher ash content. Oven-dried meal made from this offal had a protein content of 53.1 percent (55.6 percent on a dry-matter basis) as compared with the protein content of 71.2 percent (73.0 percent on a dry-matter basis) for oven-dried offal of eviscerated haddock. Again, the protein content of the meal prepared by the boiling solvent method from haddock offal with the viscera included increased to a value of 67.6 percent (70.0 percent on a dry-matter basis). A sharp difference in fat content is evident, it being 18.6 percent (24.0 percent on a dry-matter basis) for the oven-dried meal and 1.5 percent (1.6 percent on a dry-matter basis) for the solvent-dried meal.

SUMMARY

The Service's East Boston Fishery Technological Laboratory obtained commercial samples of fish meal and oil from the various fish-reduction plants in New England. These meals and oils were scheduled to be used in a nationwide research project to determine factors affecting the nutritive value and use of fishery byproducts. Those samples obtained were representative of the production of the New England fishery byproducts manufacture. The meals collected were ocean-perch meal, herring (sardine) meal, menhaden meal, and whiting meal. Pertinent data. such as the history of the raw material used and the processing techniques employed, were obtained with each sample. The proximate composition of each meal was determined--moisture, protein, fat, and ash content. The samples were then sent to contractors for further evaluation

THE COLOR OF THE SEA

The sea is not always blue, but may vary from an indigo, or deep blue, to an intense green, or in certain circumstances brown or brown-red. Blue waters are typical of the open oceans, particularly in the middle or lower latitudes, whereas green water is more common in coastal areas, and the brown or "red" waters are usually observed in coastal regions only. The blue color can be explained as a result of the scattering of light against the water molecules themselves, or against suspended minute particles smaller than the shortest visible wave lengths. The blue color of the water is therefore comparable to the blue color of the sky.

The transition from blue to green color, however, cannot be explained as a result of this scattering, and it has been pointed out that a "yellow substance," which seems to be a metabolic product of plant plankton and which occurs in greatest abundance in coastal areas, in combination with the "natural" blue of the water, leads to a variety of shades of the green colors which are observed at sea.

When water is full of silt or other suspended large particles, the sea may take on the colors of the particles. Discoloration can be observed when large quantities of suspended mineral particles are carried into the sea after a heavy rainfall. This also may occur when very large populations of certain kinds of microscopic algae or dinoflagellates, such as those found in the "red tide," are present very near the surface. Thus, the "red water," which is actually more often brown than red, which is observed in many areas and after which the Red Sea and the Vermillion Sea in the Gulf of California have been named is due to the abundance of certain algae or dinoflagellates.

--"Sea Secrets" The Marine Laboratory
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