VITAMIN A IN 155 GRAYFISH LIVERS

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ABSTRACT

Data are presented on the analyses of 155 livers taken from grayfish (Squalus suckleyi) caught in otter-trawl gear that was being operated in the Gulf of Georgia, Washington, May 15, 1945. The male fish averaged 26.1 inches in length, and 33 percent were mature. The female fish averaged 30.1 inches in length, and 7 percent were mature.

The analytical data conformed to the findings of earlier studies; that is, the oil content of the livers and the vitamin A potency of the liver oil tended to increase as the fish increased in size. It was also confirmed that the vitamin A potency of the liver and of the liver oil varies greatly from one grayfish to another.

Three conclusions were drawn from the work:

1. Care should be taken in sampling grayfish livers, as otherwise the sample may not be representative of the lot.
2. There are factors associated with the vitamin A content of the grayfish livers that have not yet been determined.
3. The taking of small grayfish is not economically sound.

INTRODUCTION

At present, knowledge of the factors associated with the vitamin A potency of grayfish livers is based upon measurements made on less than 1,500 individual specimens. Because of the great variation in the vitamin A content of the individual fish livers, and the large number of other variables involved, it is difficult to determine the true factors controlling the vitamin A content of the livers. For this reason, data on grayfish caught May 15, 1945, although based upon only 155 specimens, are presented here in the belief that they will help in the eventual clarification of the various vitamin A relationships.

Table 1 - Number, Size, Maturity, and Sex of Grayfish (Squalus suckleyi) Taken in Individual Otter-Trawl Drags Made in the Gulf of Georgia, May 15, 1945

Drag Number	No. of Fish Caught	Average Length of Fish	Relative Number of Mature and Immature Fish
		Inches	Percent Mature
	MALES		
1A	7	27.4	43
2A	11	26.3	45
2B	10	28.0	60
2C	29	25.1	17
Average	14	26.1	33
	FEMALES		
1A	9	35.4	33
2A	39	28.9	0
2B	25	29.9	8
2C	25	29.9	8
Average	24	30.1	7

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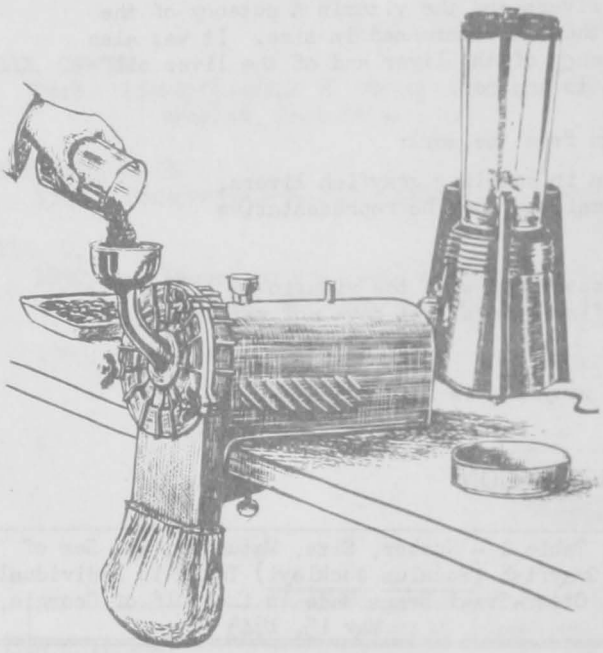
The data are a result of a cooperative project by members of the Washington State Department of Fisheries and the Seattle Technological Laboratory of the Fish and Wildlife Service.

SOURCE OF SPECIMENS

Specimens used in this study were obtained by commercial fishermen who were employing otter-trawl gear in the Gulf of Georgia, a short distance from Blaine, Washington. Data on the fishing trials are given in Table 1. After the first drag (1A) had been made, one of the cables attached to an otter-trawl board broke. Observers immediately transferred to a second trawler from which the next three drags (2A, 2B, and 2C) were made. Each drag required about two hours and averaged 38 grayfish. Almost all of the fish were small, and only 17 percent were mature.1/

PREPARATION OF LIVERS



Earlier work (Pugsley 1943; Sanford and Bonham 1947; Swain 1947) had shown that the size, sex, and sexual maturity of the grayfish are variables that must be considered if other factors associated with the vitamin A content of their livers are to be evaluated. Therefore, in the present study, the sex, sexual maturity, and length of each fish were noted. The livers were weighed and then ground individually in a meat chopper, using a plate containing holes one-eighth inch in diameter. The material was further comminuted in a Waring blendor.

MEASUREMENT OF OIL AND VITAMIN A

The oil and vitamin A were extracted using the "shaking method." Specifically, this method is as follows: Four grams of the liver were weighed into a tared, 2-ounce bottle. Exactly 25 milliliters of petroleum ether and about 15 grams of anhydrous sodium sulfate were added, and the bottle and its contents were agitated for 1 hour by means of a shaking machine. The bottle was centrifuged and an aliquot portion of the petroleum ether solution was diluted with isopropanol to such a volume that the optical density of the resulting solution was within the range 0.2 to 0.8. The density readings were made using a Beckman spectrophotometer.

To determine the oil content of the liver, a 5-milliliter aliquot portion of the petroleum-ether solution in the shaking bottle was pipetted into a tared, 50-milliliter Erlenmyer flask. The solvent was evaporated by passing a gentle flow of air over the solution while the flask was immersed for about 10 minutes in a water bath at a temperature of 80° to 90° C. The flask and its contents were allowed to cool at room temperature for 45 minutes and was then weighed.

1/A female was judged to be sexually mature if it had eggs or embryos in the uteri. A male was judged mature if sperm was present in the seminal vesicle.

Samples were run in duplicate to guard against gross error.

GROUPING OF DATA

Because of the large variability in the properties of the individual livers, the trends in the measurements can best be seen by grouping the data and considering averages rather than individual values. The bases for grouping the data obtained in this study were the sex, sexual maturity, and length of the fish from which the livers were taken. The length groupings chosen were arbitrarily set at 2-inch intervals. Thus, for the immature males, the first group was composed of livers from fish 18.0 to 19.9 inches in length; the second group was composed of livers from fish 20.0 to 21.9 inches in length; the remaining livers were similarly grouped.

RESULTS AND DISCUSSION

Results are given in Table 2. In general, the data show that both the oil content of the liver and the vitamin A potency of the liver oil increase as the fish grow in size. However, in spite of grouping the data, these trends are somewhat obscured. For example, the 31.1-inch males yielded a liver oil of higher vitamin A potency than the 32.7-inch males.

When the groupings are made larger, the trends become apparent. Thus, when a weighted average of the data was taken, the oil content of the livers of the immature males was 54.7 percent in contrast to 58.9 percent for the livers of the mature males. The immature females had livers containing an average of 65.2 percent oil as compared to 67.7 percent for the mature females.

The difference between the vitamin A potency of the liver oil of the mature fish and immature fish was considerable. Liver oil from the immature males averaged 2,810 units of vitamin A per gram whereas the oil from the mature males had an average potency of 5,270 units. Liver oil from the immature females averaged 4,320 units in comparison to the oil from mature female fish livers which averaged 19,350 units of vitamin A per gram. Thus, while there was great variability between individual livers, a comparison of the weighted averages for the immature and mature fish brings out the trends clearly.

The great variability between individual livers or between small groups of livers should serve as a warning to those in the trade that it is extremely difficult to obtain a sample that is representative of the lot.

This variability, after the fish have been separated on the basis of sex, sexual maturity, and length, shows that there are other factors associated with the vitamin A content of the livers that have not yet been determined.

Of particular interest to the fishermen is the column in Table 2 showing the average vitamin A content per liver, because it enables him to estimate the value of the individual fish. For example, the smallest females averaged 0.016 million units of vitamin A per liver; assuming that the current price of vitamin A is 16 cents a million units, these livers were worth 1/4 cent apiece.

The large grayfish are more valuable than the small ones. This is because three factors are operating concurrently as the fish increase in size:

1. The livers become larger.

2. The livers tend to contain more oil.

3. The oil tends to contain more vitamin A.

Thus, the largest female reported in Table 2 had a liver which contained 8.36 million units of vitamin A, whereas the smallest females had livers containing an average of only 0.016 million units. Hence, the fishermen would have to catch, handle, and remove the livers from 523 of the small fish to obtain the same amount of vitamin A as is found in the liver of this one large female--dramatic evidence that the taking of small grayfish is not a sound policy.

Table 2 - Data on Grayfish (Squalus suckleyi) Caught in Strait of Georgia, May 15, 1945

Number of Specimens in Each Group	Average Length of Specimens	Average Weight of Livers	Average Oil Content of Livers	Average Vitamin A Potency of Liver Oil	Average Vitamin A Potency of Livers	Average Vitamin A Content per Liver
	Inches	Pounds	Percent by Weight	"Spec" Units[1] per g. Oil	Millions of "Spec" Units per lb. of Liver	Millions of "Spec" Units per Liver
			IMMATURE MALES			
1	18.3	0.040	44.7	440	0.09	0.004
3	21.0	0.062	44.9	2040	0.42	0.026
9	23.0	0.097	53.1	2630	0.63	0.061
18	24.7	0.147	56.5	2830	0.73	0.107
4	26.5	0.154	58.3	2300	0.61	0.094
3	28.9	0.177	57.0	5460	1.41	0.250
			MATURE MALES			
3	27.2	0.224	62.6	2260	0.64	0.143
9	28.5	0.209	58.6	3740	1.00	0.209
3	31.1	0.221	52.1	14380	3.40	0.751
4	32.7	0.318	62.0	4160	1.17	0.372
			IMMATURE FEMALES			
2	19.2	0.068	53.8	960	0.23	0.016
1	20.7	0.096	48.6	560	0.12	0.012
4	22.5	0.100	55.7	1610	0.41	0.041
10	24.5	0.159	61.3	1940	0.54	0.086
19	26.9	0.201	58.1	3560	0.94	0.189
20	28.7	0.288	64.2	4580	1.33	0.383
15	30.6	0.390	68.8	7100	2.22	0.866
10	32.7	0.607	73.7	5090	1.70	1.03
2	34.7	0.717	72.1	5560	1.82	1.30
8	36.4	0.992	77.7	4670	1.64	1.62
1	40.4	1.68	79.4	4400	1.59	2.68
			MATURE FEMALES			
2	37.9	0.721	65.1	25000	7.39	5.33
2	42.4	0.838	64.8	21100	6.20	5.20
1	43.7	1.83	77.2	10500	3.68	6.75
1	46.5	1.99	69.0	13400	4.20	8.36

1/ 2000 x e (1%, 1 cm., 328 mmu., isopropanol).

CONCLUSIONS

(1) There is a great variability in the vitamin A content between individual grayfish livers or between small groups of the liver; therefore, unless special techniques are followed in sampling grayfish livers, the sample may not be representative of the lot.

(2) There are major factors associated with the vitamin A content of the grayfish liver that have not yet been determined.

(3) The taking of small grayfish is not economically sound.

LITERATURE CITED

PUGSLEY, L. I.
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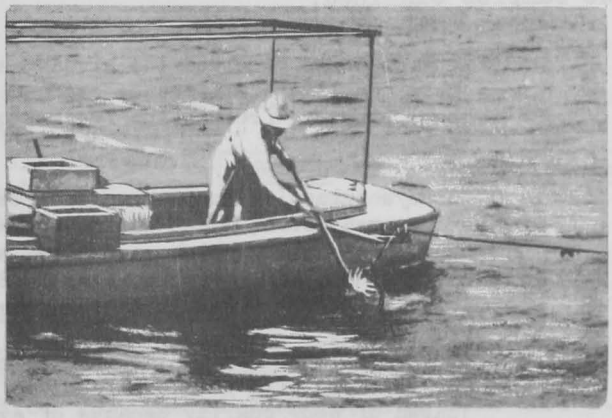
1947. Relationship between body length of grayfish and vitamin A in liver. Commercial Fisheries Review, vol. 9, no. 9, pp. 1-7.

SWAIN, LYLE A.
1947. Vitamin A in dogfish livers. Fisheries Research Board of Canada, Progress Reports of the Pacific Coast Stations, no. 73, p. 57.

TROTLINE CONSTRUCTION, OPERATION, AND MAINTENANCE

(CHESAPEAKE BAY TYPE)

Trotlines, as used in the Chesapeake Bay area, are usually made of 3/8-inch diameter cotton rope and vary from one-quarter of a mile to one mile in length. At each end of the line an anchor is placed in the form of an iron chain weighing about 10 pounds and a colored buoy for identification and location of the set. Chain is used instead of a grapnel because it will allow for slight adjustments in "running out" the line and because it can be stored in or near the line barrel without entangling the line.



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