

VITAMIN A AND D POTENCIES OF THE LIVER OIL OF PACIFIC COD (GADUS MACROCEPHALUS)

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ABSTRACT

Incidental to the observations on the king crab by the Alaska King Crab Investigation in 1941, a number of cod livers were taken for oil and vitamin analyses. As the season advanced from May to August, the oil content of the livers increased while the vitamin A potency of the liver oil decreased. During the early part of the season, the increase in oil content was faster than the increase in vitamin A content. During July and early August, the change in vitamin A potency of the oil was not great. The average for the entire catch was 1.29 million units of vitamin A per pound of liver.

Limited data on small samples of male and female cod livers taken from fish 30 to 33 inches in length on July 1947 are given.

The vitamin D potency of the composite liver oil was 200 U.S.P. units per gram of oil.

INTRODUCTION

Incidental to the observations on king crab by the Alaska Crab Investigation^{1/} in 1941, a number of samples of cod livers were taken for oil and vitamin A analyses. These livers were of particular interest, because, at that time, none was being processed. As a consequence, many tons were discarded at sea as a waste byproduct of the cod fishery. The results of the analyses indicated that Pacific cod livers are a marginal source of vitamin A which might be utilized at a profit under favorable market conditions.

EXPERIMENTAL

Mechanics of Sample Preparation

By 1947, the price of vitamin A was high enough to warrant saving the livers. A large quantity was brought to Seattle for processing, and the laboratory staff was fortunate in being able to core-sample a substantial proportion of them. The livers sampled were frozen in 5-gallon cans, and the cores were taken by means of an electrically-driven drill.^{2/} Two cores were taken from each can. They were then combined and mechanically mixed until homogeneous. A quart of this material constituted the sample.

At the laboratory, the liver material was further comminuted by means of a Waring-type blender. The oil and vitamin A were then extracted by means of the

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1/ "Report of the Alaska Crab Investigation," Fishery Market News, Vol. 4, No. 5a (May 1942-Supplement).

2/ Sanford, F. B.; Bucher, G. C., "Drill Sampling Device for Fish Livers," Industrial and Engineering Chemistry, Analytical Edition, Vol. 18, No. 4, (April 1946), pp. 269-271.

Also Fishery Market News, Vol. 6, No. 11, (November 1944), pp. 6-11; and Fishery Leaflet 141.

shaking method.^{3/} Ethyl ether was used as a solvent instead of the petroleum ether directed by the method.

DISCUSSION AND RESULTS

Results of the analyses are given in Table 1. Since the samples were large, the results can be considered representative—at least for the year 1947. As the

Table 1 - Data for Cod Livers Taken During 1947

| Identification of Samples | Fishing Area (Alaskan waters) | Fishing Period | Livers From Which Samples Were Taken | Oil Concentration in Livers | Vit. A Potency of Liver Oil | E Value Ratios of Liver Oil | | Vit. A Potency of Liver Oil |
|---------------------------|--|----------------|--------------------------------------|-----------------------------|------------------------------------|-----------------------------|----------------|-----------------------------------|
| | | | | | | E 300 E 328 | E 350 E 328 | |
| | | Dates | Number | % by Weight | Spec. units per gram ^{1/} | | | Millions of spec. units per pound |
| Z | Black Hill, Nelson Lagoon, Port Moller | 5/25-6/2 | 10,426 | 28.1 | 14,000 | 0.655 | 0.648 | 1.79 |
| Y | Port Moller | 6/5-18 | 17,664 | 31.7 | 11,000 | 0.663 | 0.649 | 1.58 |
| X | Cape Seniavin | 6/18-7/4 | 17,949 | 33.7 | 8,260 | 0.702 | 0.640 | 1.26 |
| W | Port Heiden | 7/4-18 | 13,932 | 39.4 | 5,590 | 0.658 | 0.648 | 0.999 |
| U X V | Port Heiden Cape Seniavin | 7/18-8/9 | 22,241 | 41.2 | 5,380 | 0.663 | 0.639 | 1.01 |

^{1/}2000 x E (1%, 1 cm., 328 mmu., isopropanol).

season advanced from May to August, the oil content of the livers increased while the vitamin A potency of the liver oil decreased. During the early part of the season, the increase in oil content was faster than the increase in vitamin A content, so that the amount of vitamin A per unit weight of liver decreased. During July and early August, the change in the vitamin A potency of the oil was not great, and the amount of vitamin A per unit weight of liver remained almost constant. (Hence, if only a limited space is available on board ship for storing the livers, they should be taken during the early part of the season.) The weighted average for the entire catch was 1.29 million units of vitamin A per pound of liver. This compares closely with the average of 1.18 million units obtained for the year 1941.

Small samples of livers were available from fish 30 to 33 inches in length. The results of these analyses are presented in Table 2. Due to the limited nature of these data, no conclusions can be drawn.

Table 2 - Data on Small Samples of Male & Female Cod Livers Taken From Fish 30-33 Inches in Length on July 7, 1947

| Sex of Fish | Weight of Sample | Oil Concentration in Livers | Vit. A Potency of Liver Oil | E Value Ratios of Liver Oil | | Vit. A Potency of Livers |
|-------------|------------------|-----------------------------|-----------------------------|-----------------------------|----------------|------------------------------|
| | | | | E 300 E 328 | E 350 E 328 | |
| | Pounds | % by Weight | Spec. units per gram | | | Mill. of spec. units per lb. |
| Male | 5.75 | 35.6 | 7,020 | 0.715 | 0.646 | 1.16 |
| Female | 6.25 | 33.3 | 8,640 | 0.692 | 0.634 | 1.31 |

The vitamin D potency was determined on a composite sample of liver oil. This assay was conducted in accordance with the method promulgated by the Association

^{3/}Anonymous, "Preliminary Procedures for the Analysis of Vitamin A in Fishery Byproducts," (Method A), Commercial Fisheries Review, Vol. 9, No. 1, (January 1947), pp. 40-41.

of Official Agricultural Chemists, but only 6 to 10 chicks were used in each group. The potency of the cod liver oil, according to this assay, was 200 U.S.P. units of vitamin D per gram.

It is interesting to compare the results obtained by us for the Pacific cod with those obtained by Pugsley, Morrell, and Kelly⁴ for the Atlantic cod. It would appear that the livers of the Atlantic cod contain somewhat more oil, but that the vitamin A and possibly the vitamin D potencies cover roughly the same ranges.

⁴Pugsley, L. I.; Morrell, C. A.; and Kelly, J. T. "A Survey of the Vitamin A and D Potencies of the Liver Oil of Atlantic Cod (*Gadus morrhua* L.), Canadian Journal of Research, Vol. 23, (July 1942), pp. 243-52.

ABSTRACT: A survey has been made of the variations and of some of the factors influencing the variations of the vitamins A and D potencies of the liver oil of cod landed at ports in Nova Scotia, New Brunswick, and the Gaspé peninsula of Quebec. An increase in the vitamin A potency was paralleled by an increase in the vitamin D potency and the oil content of the liver increased with the percentage liver in the fish. An increase in the oil content of the liver and of the liver content of the fish was accompanied by a decrease in the concentration of vitamins A and D in the oil. The vitamin potency of the oil tended to decrease as the fishing season advanced from June to October and the oil content of the liver increased during this period. When the yield of vitamins was expressed per 100 gm. of fish there was no apparent seasonal change in potency indicating that the seasonal changes observed were due to dilution. A relationship was observed between the stages in the spawning cycle and the oil content of the liver. Fish classed as "steaks" (six to eight years) yielded a liver oil higher in vitamins A and D potencies than "market cod" (four to six years) and the liver oil of "scrod" (three to four years) had the lowest vitamins A and D potencies.



BAKED LAKE TROUT

| | |
|---|---------------------------|
| 3 or 4 pound dressed lake trout | 3 slices bacon (optional) |
| 4 tablespoons butter or other fat, melted | 1½ teaspoons salt |

Clean, wash, and dry fish. Rub inside and out with salt. Place fish in a greased baking pan. Brush with melted fat and lay slices of bacon over the top. Bake in a moderate oven 350° F. for 40 to 60 minutes or until fish flakes easily when tested with a fork. If fish seems dry while baking, baste occasionally with drippings or melted fat. Serve immediately on a hot platter, plain or with a sauce. Serves 6.

Other dressed fish may be used in the above recipe.