CXCVIII. THE DIET OF THE HALIBUT AND INTENSITY OF FEEDING, IN RELATION TO THE VITAMIN A POTENCY OF THE LIVER OIL.

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In an endeavour to elucidate the factors responsible for the observed wide variations in the vitamin A potency of halibut-liver oil [Lovern *et al.*, 1933], examinations were made of the stomach contents of a number of fish. The method adopted was to furnish the skippers of the vessels supplying the livers with a typewritten form, on which, amongst other information, they wrote down the nature of the stomach contents (as far as ascertainable) of all their catch of halibut. Any material which they could not readily identify was placed in bottles of formalin, supplied for the purpose, and brought back for identification at the Torry Research Station.

It was realised from the outset that food found in the stomachs only gave evidence of the nature of the last meal, and was no clue to the type of food on which the fish had been feeding for some time. However, it was hoped that some light might be thrown on the source of the unusually large supplies of vitamin A present in the liver of the halibut—even in the poorest specimens. The results, however, were entirely negative. In many cases the stomachs were empty, but the actual food found was of so varied a nature as to suggest that the halibut ate anything they could get. The commonest species found in the stomachs were torsk, dogfish, catfish, small dabs, and crustaceans, with many other specimens, such as megrims, ling, *Sebastes norvegicus, etc.* In some cases remains of herring were found, but it could not be decided whether these had come from the bait or not.

It was evident from the vitamin A potencies of the liver oils (as measured by the antimony trichloride reaction) that no relationship could be adduced between high potency and any particular diet. None of the species found in the stomachs is an unusually rich source of vitamin A, although the one sample of torsk-liver oil which was examined was superior to most cod-liver oils. It may be worth noting that torsk was found in the stomachs more frequently than any other species.

As the diet seemed to be of so general a nature, with no outstandingly rich supply of vitamin A, it was decided to try to get some measure of the intensity of feeding. For this purpose, the glycogen content of the livers was chosen as a criterion. Admittedly it has obvious drawbacks. It is not known, for instance, to what extent intensive feeding, on a diet mainly of proteins and some fat, would affect the liver glycogen content, nor is it known to what extent, or how quickly, struggling of the fish on the line would deplete the liver reserves of glycogen. In any event, wide variations in glycogen content were experienced, so large, in fact, that it seems the most feasible explanation to ascribe them to dietary causes. Even so, it is extremely doubtful if the values have reference to anything more remote than the last meal of the fish, but no other means of investigating intensity presented itself.

From fish brought aboard a great-line vessel fishing the Faroes grounds the livers were immediately cut out and weighed, a sample of each being preserved in 60 % KOH for estimation of glycogen on return of the vessel to port. The remainder of the livers, used for oil and vitamin A analyses, was stored in ice in two batches; A, all livers under $\frac{3}{4}$ lb. in weight, B, all livers over $1\frac{1}{2}$ lbs. in weight. The data obtained from the first two experiments are given in Table I. Vitamin A potencies are expressed as blue units per 0·2 cc. of 20 % solution.

Table I.

Trip No.	Weight of whole livers (lbs.)	No. of livers in lot	Variation in glycogen (g. per 100 g. liver)	Average glycogen (g. per 100 g. liver)	Oil (%)	Vitamin (blue units)
1	$< \frac{3}{4}$	17	Trace–7·47	1·57	16	269
	$> 1\frac{1}{2}$	10	Trace–4·78	1·71	18	1366
2	$< \frac{3}{4}$	21	0·04–0·90	0·45	18	386
	$> 1\frac{1}{2}$	8	0·05–0·79	0·33	20	1337

So great were the individual differences in glycogen values that in two later experiments a somewhat different procedure was followed. In place of storing the remainder of the livers in two large batches, each liver was stored separately until the glycogen values were obtained. The livers were then put into lots according to glycogen concentration. The results are given in Table II.

Table II.

Trip No.	Weight of whole livers (lbs.)	No. of livers in lot	Variation in glycogen (g. per 100 g. liver)	Average glycogen (g. per 100 g. liver)	Oil (%)	Vitamin (blue units)	Mean
3	$< \frac{3}{4}$	8	0·01–0·18	0·09	12·5	975	
		6	0·22–0·98	0·49	12·0	1469	1080
		6	1·58–3·27	2·2	18·1	797	
	$> 1\frac{1}{2}$	5	0·13–0·62	0·38	22	1742	1319
		3	1·48–1·82	1·67	22	897	
4	$< \frac{3}{4}$	8	Trace–0·56	0·27	20	283	
		4	0·72–1·67	1·12	18	699	407
		4	2·92–6·50	4·28	18	238	
	$> 1\frac{1}{2}$	4	Trace–0·27	0·13	25	663	
		3	0·79–1·02	0·94	18	550	583
		3	3·92–6·35	5·04	20	537	

The tables show clearly that there is no relation between the vitamin potency of the oil and the glycogen content of the liver.

For each experiment the mean value for vitamin A potency is lower for the small livers than for the large ones, this being further evidence in favour of the conclusions already arrived at [Lovern *et al.*, 1933] regarding age of fish as a factor influencing liver oil vitamin A potency.

Summary.

(1) The diet of the halibut is of a general nature, with no outstandingly rich source of vitamin A to account for the high potency of halibut-liver oil.

(2) Taking the glycogen content of the liver as a criterion of intensity of feeding no correlation could be established between intensity of feeding and the vitamin A potency of the oil.

(3) Further evidence was obtained that in general the livers of older fish afford a more potent oil than those of younger fish.

REFERENCE.

Lovern, Edisbury and Morton (1933). *Biochem. J.* **27**, 1461.