

Vitamin B₁₂ in Marine Fish

IN the course of a comparative investigation of the vitamin contents of different organs from fish¹, a rather interesting relative distribution, and in some cases unusually high concentrations, of vitamin B₁₂ were observed. As the importance of vitamin B₁₂ in marine ecology has been emphasized in recent reports²⁻⁶, a brief account of the main findings is given in this communication.

Vitamin B₁₂ was determined by microbiological assays with *Lactobacillus leichmannii*. To ensure that the growth-promoting activity measured was derived from vitamin B₁₂, checks were carried out by paper chromatography.

Although most organs have been investigated the complete results cannot be reported here. In Table 1 are shown the results of analyses of: muscle, kidney, liver and heart from some species. The most striking results are the frequent high values for vitamin B₁₂ in the heart: single values up to 5 µgm. vitamin B₁₂ per gm. fresh weight (20.8 µgm. per gm. dry weight) were found in hearts from the pollack (*Gadus pollachius*). So far as we know such high concentrations are very unusual in any natural source⁸. Another interesting result was the relation between the vitamin B₁₂ content of liver and heart. In some cases the heart showed up to 150 times the value for the liver in the same fish. Normally, kidney and liver are recognized as the organs richest in vitamin B₁₂⁷, but the present findings show that in fish the heart often contains the highest concentration. Tarr *et al.*⁸ found in the kidney of the sockeye-salmon 18 µgm. vitamin B₁₂ per gm. solids. Several other organs from this fish were also investigated, but unfortunately not the heart. In none of the species I investigated were such values for kidneys encountered.

Table 1. THE VITAMIN B₁₂ CONTENT OF SOME ORGANS FROM FISHES

Species	µgm. vitamin B ₁₂ per gm. fresh weight			
	Muscle	Kidneys	Liver	Heart
Cod (<i>Gadus morrhua</i>)	0.005	0.045	0.045	1.85
Coalfish (<i>Gadus virens</i>)	0.035	0.070	0.14	0.50
Pollack (<i>Gadus pollachius</i>)	0.018	0.16	0.33	4.25
Haddock (<i>Gadus aeglefinus</i>)	0.018	0.32	0.067	2.58
Ling (<i>Molva molva</i>)	0.006	0.20	0.11	0.26
Tunny (<i>Thunnus thynnus</i>)	0.037	0.35	3.53	0.85
Plaice (<i>Pleuronectes platessa</i>)	0.022	0.37	5.00	0.81

So far the general picture seems to be that undernourished fish with very fat livers show low values for vitamin B₁₂ in the livers and often very high values for the heart. Fat fish with 'normal' livers usually show the highest values for this organ, although high concentrations are also encountered in the hearts.

The results from the plaice (*Pleuronectes platessa*) deserve some comments. This fish lives in shallow waters where both the sea and most of its food may be expected to contain relatively high concentrations of vitamin B₁₂. It is therefore interesting to note the relatively high average value for the liver from this fish. Actually, in one of the samples from plaice the liver contained 8 µgm. vitamin B₁₂ per gm. fresh weight (50 µgm. per gm. fat-free dry weight).

The results emphasize the position of the fish in the turnover of vitamin B₁₂ in marine life. A

detailed account of this work will be published elsewhere.

OLAF R. BRÆKKAN

Governmental Vitamin Laboratory,
Norwegian Fisheries Research Institute,
Bergen. Aug. 25.

¹ Brækkan, O. R., Report on Technological Research concerning the Norwegian Fish Industry, 3, No. 3 (1955); *ibid.*, 3, No. 6 (in the press).

² Ford, J. E., and Hutner, S. H., "Vitamins and Hormones", 13, 101 (1955).

³ Droop, M. R., *Nature*, 174, 520 (1954); *J. Gen. Microbiol.*, 16, 236 (1957).

⁴ Cowey, C. B., *J. Mar. Biol. Assoc.*, 35, 609 (1956).

⁵ Droop, M. R., and Daisley, K. W., *Nature*, 180, 1041 (1957).

⁶ Adair, E. J., and Vishniac, H. S., *Science*, 127, 147 (1958).

⁷ Jukes, T. H., and Williams, W. L., in "The Vitamins", 476, edit. by Sebell, W. H., and Harris, R. S. (New York, 1954).

⁸ Tarr, H. L. A., Southcott, B. A., and Ney, P. W., *Food Technol.*, 4, 354 (1950).

Deoxyribonuclease Activity and Deoxyribonucleic Acid Synthesis in Normal, Regenerating, Precancerous and Cancerous Rat Liver

INCREASE in the rate of deoxyribonucleic acid synthesis is a biochemical characteristic of hyperplastic growth. Whereas the rate of growth under normal conditions is under rigorous control, malignant growth may be characterized by the impairment of this kind of control. Since deoxyribonucleic acid synthesis is necessary for cell division, it is possible that this control may be exercised by the regulation of deoxyribonucleic acid metabolism. The purpose of this communication is to direct attention to a number of observations which, taken together, seem to indicate that deoxyribonuclease may be involved in such regulation.

In previous experiments^{1,2} a close correlation between the activity of a deoxyribonuclease with pH optimum close to 5 and growth-rate or rate of synthesis of deoxyribonucleic acid has been demonstrated in normal tissues; increase in growth-rate was in all cases studied associated with increase in the level of deoxyribonuclease activity per cell. In contrast to this pattern in normal tissues, a lack of correlation between growth-rate and deoxyribonuclease activity was found in a series of malignant human and animal tissues³. The deoxyribonuclease activities of the tumours were approximately equal to, or lower than, those found in the tissues of origin.

In the search for an explanation of these apparent differences between normal and malignant growth, a systematic study has been made of the deoxyribonuclease activity in rat liver in various types of normal and malignant growth. Such a study makes possible a comparison of these various conditions in a single organ. Male Sprague-Dawley rats, weighing 250-300 gm., were used. The enzymic activities were determined in normal adult liver, in regenerating liver after partial hepatectomy, and in precancerous and cancerous livers, where the tumour was induced by feeding a rice diet containing 0.06 per cent *p*-dimethylaminoazobenzene⁴ and supplemented with carrots. After three months, casein was added to the diet. The deoxyribonucleic acid phosphorus content and deoxyribonuclease activities were determined as described previously⁵.

Table 1 is a summary of some of the results. Compensatory hyperplasia after partial hepatectomy is accompanied by an increase in deoxyribonuclease activity; the increase is very rapid and is observed