

using pyridine/water as solvent<sup>4</sup>, of these extracts after concentration by freeze drying showed larger brown non-fluorescent streaks in samples from frozen tissue than from fresh tissue, but no clearly defined diphosphopyridine nucleotide spot was detected.

The loss of coenzyme I content on freezing would not appear to be due to enzyme activity as the time for any breakdown is too short and the temperature too low. It also does not appear to be a simple inhibition in the fluorescence estimation. Thus apparently during freezing some physico-chemical phenomenon takes place.

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## ANIMAL PHYSIOLOGY

### Water Content of Cod (*Gadus callarias* L.) Muscle

IN fatty fish such as herring the protein content of the flesh does not show any regular cycle of changes throughout the year<sup>1,2</sup>. Marked variation is shown by the fat, however, which decreases in times of food scarcity, the flesh showing a corresponding increase in water content. Non-fatty fish such as cod do not behave in this way, and in times of scarcity they draw on their body proteins both for metabolic purposes and for building up the gonads<sup>3</sup>. Water then takes the place of the protein, and in the case of cod artificially starved to the point of death it can increase to as much as 88 per cent of the flesh as compared with about 80.5 per cent in normal fish<sup>4</sup>.

Although many determinations of the water content of fish muscle have been carried out, the rather small variations encountered in non-fatty fish landed at commercial ports have rarely been commented on. The following results show, however, that considerable biological information can be obtained from them.

The cod analysed were all obtained from the same ground, about 30 miles south-east of Aberdeen. They were filleted within 12 hr. of being caught, and myotomes 8-16, approximately (counting from the anterior end of the fillet) were dissected out free from myocommata (connective tissue) and placed in weighed basins, approximately equal weights of material being taken from each fish in a sample. Water was determined by drying in an oven at 100° C. for seven days.

Three size-groups of fish were used: (1) 20 in. long or less (sexually immature); (2) close to 30 in. long (about the size when they become mature); (3) 36-42 in. long (mature). It was difficult to get fish in the latter group at certain times of the year, and each sample consisted of pooled material from only 1-8 such fish. Material from medium-sized fish

was obtained from 10 individuals, while 20 individuals were used for the 'small' group.

The results (Fig. 1) show that the water content is affected by the size of the fish as well as by the season, the maximum in March corresponding with the period of spawning. Not only is tissue hydration greater in larger fish than in smaller, but in addition it lasts longer (about 3 months). The smallest fish are affected for just one month, recovering in April, and it is likely that this effect is due solely to starvation, since the fish are immature. The findings are in accordance with previous observations<sup>3</sup>, which showed that the reduction in protein nitrogen was greater in larger fish than in small, owing to the additional need of larger fish to build up gonads on a food supply inadequate even for ordinary metabolism.

There is little doubt that the height of the maximum in Fig. 1, and also its location, depends on the place where the fish were caught, and probably on the year of catching as well. The highest water content that we ever found under natural conditions (87.2 per cent) was in a cod 42 in. long caught off the west coast of Scotland at the beginning of June 1959. The maximum in Fig. 1 is in March 1959, so this isolated observation provides an example of the effect of a different fishing ground.

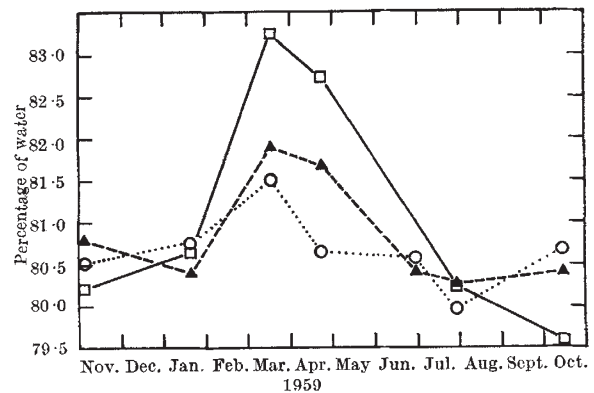


Fig. 1. The water content of cod muscle tissue at different times of the year. ○ · · · ○, Small fish; ▲ --- ▲, medium fish; □ — □, large fish. Large fish were not obtainable in June.

In a recent review of fish composition<sup>5</sup> it was recommended that in order to obtain the complete picture of the variations in a given constituent, analyses should be carried out at monthly intervals for a year on fish of at least two age groups, the fishing ground being the same throughout. From the data in Fig. 1, the recommendation would not appear to have been unreasonable.

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