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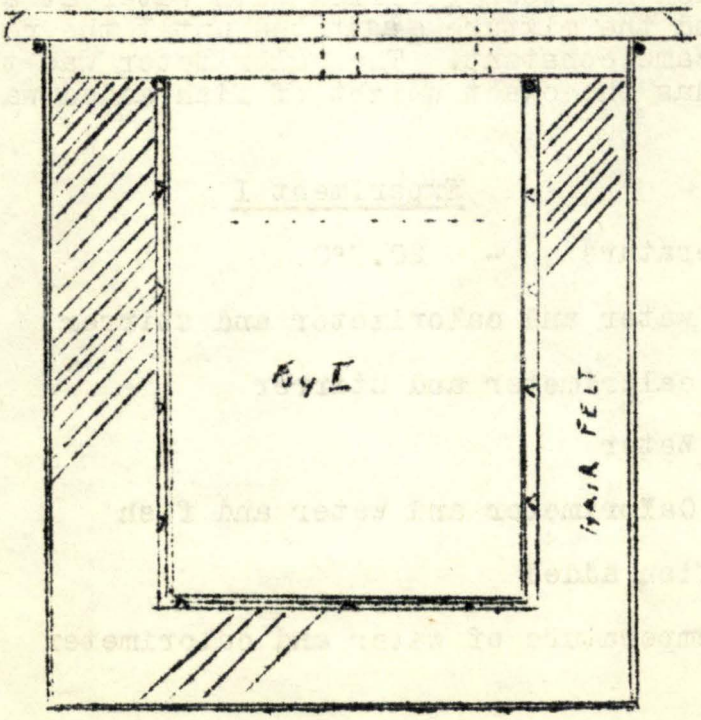
Determination of Specific Heat of Fresh Haddock Muscle

By D.B. Finn

During the work on refrigeration which was carried on at the Atlantic Experimental Station for Fisheries, it was found that a knowledge of the specific heat of fresh fish was desirable. Since data on this was not available at the station, it was found necessary to make the determination.

Muscle from fresh haddock was finely minced and placed in a closed metal vessel which was immersed in cold running water which varied between 3.8°C. to 4°C. This minced muscle was left under these conditions for 12 hours, so that the temperature throughout the mass would become constant.

The calorimeter consisted of an outer vessel of polished copper lined with hair felt which was close to, but did not touch an inner vessel also made of copper. Fig. II).



The lid was made of wood, and contained holes for thermometer and stirrer. The stirrer was made of copper wire, and was furnished with a detachable glass handle.

The method used was the well known one of "Mixtures." Experience showed that 150 grams of muscle at about 4°C. lowered the temperature of 600 grams of water at 20° to about 17°C. Accordingly in the actual experiment the initial temperature of the water was arranged so that it would be about 3°C. above the room temperature. Thus heat gains or losses from the calorimeter to the surrounding atmosphere were reduced to the minimum, and for this reason no corrections for this loss or gain were made.

The thermometers used were made by Cambridge and Paul and Baird and Tatlock. They were graduated in 1/10°C., and were checked with a Bureau of Standards instrument, and found to be correct in 5° intervals to ±0.05. During the experiment it was found that the thermometer scale projected from the calorimeter not more than 3 inches, so that no stem correction was made.

After the temperature of the minced fish had become constant, it was thoroughly mixed in order to distribute the juices which had collected at the bottom of the container.

About 100 grams of the fish were then placed in the calorimeter which had been ¾ filled with water at a known temperature, and the mixture agitated until the resulting temperature became constant. The calorimeter was then weighed, and thus the exact weight of fish added was determined.

Experiment I

Room temperature - 20.7°C.

	Weight of water and calorimeter and stirrer	542.4 gms.
M_1 -	Weight of calorimeter and stirrer	110.72 "
M_2 -	Weight of Water	431.68 gms.
	" " Calorimeter and water and fish	717.5 gms.
M_3 -	" " fish added	175.1 gms.
t -	Initial temperature of water and calorimeter	23.0°C.

t_1 - Initial temperature of fish 3.4°C.

θ - Final temperature of mixture 18.0°C.

S - Specific Heat of fish

s - " " " copper 0.095

$$S = \frac{(M_2 - M_1 s)\ (t-\theta)}{M_3\ (\theta - t_1)}$$

$$= \frac{(431.68 + 110.72 \times 0.095)\ (23.0° - 18)}{175.1 \times (18.0 - 3.4)} = 0.86$$

Experiment II

Room temperature 20.4°C.

Weight of Water and Calorimeter and stirrer 594.25 gms.

M_1 " " Calorimeter and stirrer 110.72 gms.

M_2 " " Water 483.53 gms.

Weight of Calorimeter and mixture 732.3 gms.

M_3 " " fish added 138.05 gms.

t Initial temp. of water and calorimeter 22.2°C.

t_1 " " " fish 3.2°C.

θ Temperature of mixture 18.5°C.

$$S = \frac{(483.53 + 110.72 \times 0.95)\ (22.2 - 18.5)}{138.05\ (18.5 - 3.2)} = 0.86$$

Thus the specific heat of haddock muscle is 0.86 at a temperature of 3.2 to 3.4°C. = 37.6° and 38.1°F. which is very near the temperature of fish when first placed in refrigerators.

Thanks are due to Mr. R.F. Eagar of the Nova Scotia Technical College who rendered valuable advice and assistance and kindly placed his apparatus and laboratory at my disposal.