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Notes on the Extraction of Cod Liver Oil

By H. Ritchie Chipman and Kenneth W. Mahen

The following experiments were undertaken to investigate the extraction of cod-liver oil by the direct steam method and by heating in a water bath. The work was carried out at the Fisheries Experimental Station at Halifax, N.S. The livers were in all cases fresh cod livers and were used as soon as possible after their arrival at the Station.

Direct Steam Method

In this method the livers were placed in a beaker and steam was led in by a tube which extended to the bottom of the beaker. A liter beaker was used and it was filled to about two thirds of its depth. Some of the steam would condense and the oil would float on the water and rise to the top of the beaker. The temperature of the mass of livers was not watched very closely, but on one occasion it was found to average 85° except in the immediate vicinity of the steam pipe where it reached about 95°C.

The mass of livers was subjected to steam for thirty minutes and after cooling was placed in a flannelette bag and allowed to drain over night. The oil was separated from the water by means of a separatory funnel. After draining, the chum was placed in small flannelette bags and, being placed in a press, was subjected to a weight of twenty pounds. All supplies of oil were then combined, and filtered through a layer of wood charcoal supported by cotton wool in a glass funnel. This was done to remove small particles of liver and stearin which had come through the bags. The oil obtained by this method had a good colour, odour and taste, and compared very favourably with commercial medicinal oils. It gave a very good Vitamin-A colour test, being a little higher than most of the commercial oils.

To determine whether grinding the livers made any appreciable difference, experiments were carried out with ground and whole livers. To obtain a good comparison, each liver was cut into two parts: one being used for extraction from whole livers, and the other being ground. The part used as a whole liver was merely placed in the large beaker and the steam turned on.

The livers which were ground were put through a meat grinder and ground into a pulpy mass. Considerable oil exuded during the grinding. The ground mass was received from the grinder in an evaporating dish and any oil which had been pressed out was placed in the tin with the livers. By dividing the livers into two parts as described a good comparison could be obtained as no variation would be caused by one liver being of a poorer quality.

The results of these experiments were as follows:-

Table I

	Wt. liver	Wt. oil	Percent oil
Ground	394.0	72.2	18.3
Whole	365.5	67.3	18.4

Apparantly no appreciable change in the yield is obtained by using ground instead of whole livers.

To determine the effect of time of steaming a number of livers were cut into four pieces, thus giving four lots. Oil was extracted by steam for fifteen minutes, thirty minutes, forty five minutes, and one hour. The percentage of oil obtained seemed to indicate a larger yield with a duration of thirty minutes, but the quantities used were too small to obtain accurate results. The experiment was repeated using a larger quantity and two lots. One lot was steamed for thirty minutes and the other for one hour. The following results were obtained:-

Table II

	Wt. liver	Wt. oil	Percent oil
Steamed thirty min.	463.2	122.5	26.5
Steamed on hour	444.9	111.6	25.0

Apparantly more oil is obtained after thirty minutes than after one hour, but the difference appears to be slight. It may be that a longer exposure to heat causes some emulsifying of the oil with the condensed steam. The quality of the oil seemed to be the same in both cases.

Water Bath Method

In this method the livers were placed in a tin which was immersed in a water bath. The bottom of the tin which contained the livers did not touch the bottom of the water bath, thus providing for complete surrounding by water, but the top was above the water level. The tin was provided with a cover which had an opening to permit any gases to escape. The temperature of the water bath was closely watched. Early experiments consisted of cooking the livers for thirty minutes at 60°, 70°, 80°, 90°, and 100°C., but the results were very uncertain on account of using too small a quantity. The oil was of good quality with a tendancy to become darker as the temperature of the water bath was increased. The duration of cooking was thirty minutes in each case and the oil was given the same treatment after cooking as in the case of the oil obtained by the direct steam method.

The experiments were repeated at 50° and 100°C. and the following results obtained:-

Table III

	Wt. liver	Wt. oil	Percent oil
Cooked at 50°C.	848.1	127.7	15.1
Cooked at 100°C.	849.0	215.8	25.4

These results agreed with the ones formerly obtained. The oil at 50° was much lighter than that obtained at 100°.

Further experiments at different temperatures gave the following results:-

Table IV

	Wt. liver	Wt. oil	Percent oil
Cooked at 60°	414.2	72.3	17.4
Cooked at 70°	432.2	75.3	17.4
Cooked at 100°	450.0	98.9	81.9
Cooked at 100°	384.6	91.0	23.7

The above Table shows that the amount of oil obtained increases with the temperature of the Water bath. The colour of the oil obtained at the various temperatures was noted, and it was seen that the oil was of uniform colour until 100° was reached. All the oil obtained at 100° was much darker in colour. An experiment carried out at 80° produced light oil. An experiment was carried out at 90° but unfortunately the liver was poor and there was no yield of oil.

The direct steam method appears to be very simple and gives a very good quality of oil. The yield is not apparently influenced by the duration of steaming. The oil is of good colour.

The water bath method produces a very good light oil, but the yield is not comparable with the direct steam method unless the temperature is raised to 100° C. At the point the oil appears to become darker in colour.

These experiments have only been considered as being preliminary in nature, and it is expected that several things which they have brought to light will be followed up at a later date.