The Chemical and Physical Characteristics of Cod Oil

(Industrial Cod Liver Oil)

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RECENT[1] study of the chemical and physical characteristics of medicinal cod liver oil obtained on the open market show that these characteristics vary over wide limits. In the analyses of these medicinal oils the minimum and maximum values obtained were for specific gravity 0.920 to 0.927; for refractive index 1.477 to 1.482; for saponification number 180.8 to 190.8; for iodine value 147.5 to 183.1; for free fatty acid 0.27% to 1.65% and for unsaponifiable content 0.97% to 1.40%.

In view of these results it seemed desirable to collect data concerning the chemical and physical characteristics of non-medicinal cod liver oils. Such oils although prepared from cod livers appear in the trade under the designation "cod oil." The physical appearance of non-medicinal cod liver oils is far from uniform. In color they vary from a yellow with a slight tinge of red to oils which are so dark as to be practically black. The lighter colored oils are usually quite fluid whereas some of the black oils are so viscous that they pour very slowly. The odor of cod oils increases quite consistently with the intensification of their color. In brief, the cod oils as a group vary in appearance all the way from oils that just fail to classify as medicinal cod liver oil to the dark viscous ill-smelling oils.

In general, the cod oils are prepared from livers that are more or less decomposed. The light colored cod oils are obtained from livers which may not have been removed from the fish for more than a few days. On the other hand the very heavy, dark oils are obtained from livers that may have been decomposing for months. Probably the larger portion of cod oils are produced by the so called "rotting process"—that is by the natural decomposition of the livers. However, a certain amount of cod oil is produced by cooking partially decomposed livers. The yield of oil when cooking is employed is somewhat larger than when the livers are merely allowed to decompose.

Information concerning the chemical and physical characteristics of non-medicinal cod liver oils is of particular interest because as a consequence of the extended use of cod liver oil for animal and poultry feeding, it is frequently questioned whether cod liver oil which does not meet the U.S.P. specifications as regards chemical and physical characteristics may be used for feeding animals or poultry.

In connection with the use of non-medicinal cod liver oil for animal or poultry feeding, the Federal Regulatory Service has ruled that when cod liver oil is sold as "cod liver oil" it shall meet the U. S. P. specifications as regards chemical and physical characteristics regardless of whether it is to be used for human, animal or poultry consumption. This would seem to be a perfectly proper ruling for obviously the purchaser of dog biscuit, fox biscuit, or start-growing or laying mashes for poultry reputed to contain cod liver oil has a right to expect that these products contain what has been legally defined as "cod liver oil."

Some of the best quality of non-medicinal cod liver oils just fall short of meeting the U. S. P. specifications for medicinal oil. The Federal Regulatory Service permits the sale of such oils for animal and poultry feeding purposes providing the seller designates these oils as "not U. S. P." and includes on the label a clear statment of the extent to which the oil deviates from the U. S. P. specifications. The latter provision by the Federal Regulatory Service would seem to amply cover the use of non-medicinal cod liver oil for animal and poultry feeding purposes in so far as this discussion is concerned.

Uses of Cod Oil

LARGE quantities of cod oil are used annually by the leather industry and the improvements in manufacturing conditions in that industry are making a constantly increasing demand for more exact information concerning the chemical and physical characteristics of the cod liver oil destined for use in that industry. Such oil is known in the trade under a variety of names—"cod oil," "No. 2 cod liver oil," "tanked cod liver oil," "sun-tried cod liver oil," "industrial cod liver oil," and "tanners oil." Nevertheless these oils are most generally described as "cod oil."

Formerly when practically all leather was dyed black or very dark color, cod oil of almost any description would serve the needs of the leather tanner. At present, however, when there is a large demand for light colored leathers for sport shoes, hand bags, and bookbinding, it is essential that the cod oil used in their manufacture shall be of relatively light color and of fairly uniform characteristics.

For the purpose of this study, the authors obtained from a variety of sources cod liver oils which with one exception (sample No. 871) were being offered for sale as "cod oil." Sample No. 871 was purchased on the open market as a cod liver oil for poultry. Its high acid value, dark color, odor, and general appearance were such that the authors felt that it should properly be classified as a cod oil, and, accordingly, it has been included in this study. The jobber that supplied sample No. 865 stated that inasmuch as this oil was rather light colored for a cod oil and was obtained from a concern which deals in oil for poultry feeding, it is quite possible that this oil was intended for poultry although it was sold as cod oil. In general, very little information could be secured concerning the history of the oils under consideration. Table No. 1 contains the information that was supplied concerning the oils studied.

DESCRIPTION OF COD OILS

Sample Number	Description of Sample
865	Intended for poultry feeding.
866	Cod oil.
867	Rotted oil produced in winter.
868	Pure Newfoundland cod oil.
869	Rotted cod liver oil.
870	History unknown.
871	Vitamin tested cod liver oil.
872	Tanners cod oil.
903	Cod oil used in tannery.
904	Pure Newfoundland cod oil.
905	Newfoundland cod oil—sun rotted.
906	Cod oil used by Tanning Industry.
907	Cod oil.
895	Tanked Newfoundland cod oil.
896	Pure Newfoundland cod oil.
897	English cod oil.
898	Newfoundland cod oil.
899	Pure Newfoundland cod oil.
900	Pure tanked Newfoundland cod oil.
901	Pure cod liver oil.

Such general information as that appearing in the above table in reality gives the customer practically no information concerning the nature of the oil which he has purchased. In fact, a survey of the leather industry serves to show that cod oil used for tanning is now largely bought by trade names or brands and principally on the basis of the customer's belief in the integrity of the seller. The seller, also, originally procures his cod oil under much the same conditions. Thus it is easy to appreciate why cod oils purchased under the same brand or trade name often fail to produce uniform results.

The chemical and physical characteristics of these oils were determined by the methods described in detail in the U. S. Pharmacopoeia[2]. The refractive index (not specified by the Pharmacopoeia) of the different samples of oil were determined by means of a Zeiss refractometer. The results of the chemical analyses of the cod oils under consideration are reported in detail in table No. 2.

The minimum and maximum values obtained were for specific gravity .9193 to .9266; for refractive index 1.480 to 1.483; for saponification value 184.0 to 194.5; for iodine number 146.3 to 168.6; for free fatty acid 7.24% to 20.17%; for unsaponifiable number 1.197% to 2.8%. Such a wide variation in the physical and chemical characteristics of the oils studied was to be expected in view of the wide variation in the physical appearance of the oils under consideration. These variations indicate very conclusively that different lots of cod oil as obtained on the open market are not equally adapted to the needs of a given process if uniform results are desired.

In order that the reader may more readily visualize the variation in the values obtained for the different characteristics, the values have been plotted as curves which appear in chart No. 431.

Conclusions

REFERENCE to the above chart shows that there are scarcely any two samples that have the same chemical and physical characteristics. Such information shows that there is a very definite need for developing standards for cod liver oil intended for industrial use. Establishing standards for cod oil would have a twofold effect. It would cause the cod oil producer so to control production conditions that he could supply the trade with cod oil of uniform quality which complied with the established standards. This in turn would provide the tanner with a standardized cod oil which would be of material assistance in the manufacture of uniform leather. This would particularly apply in the manufacture of chamois leather which involves a chemical reaction between collagen, the leather forming sub-

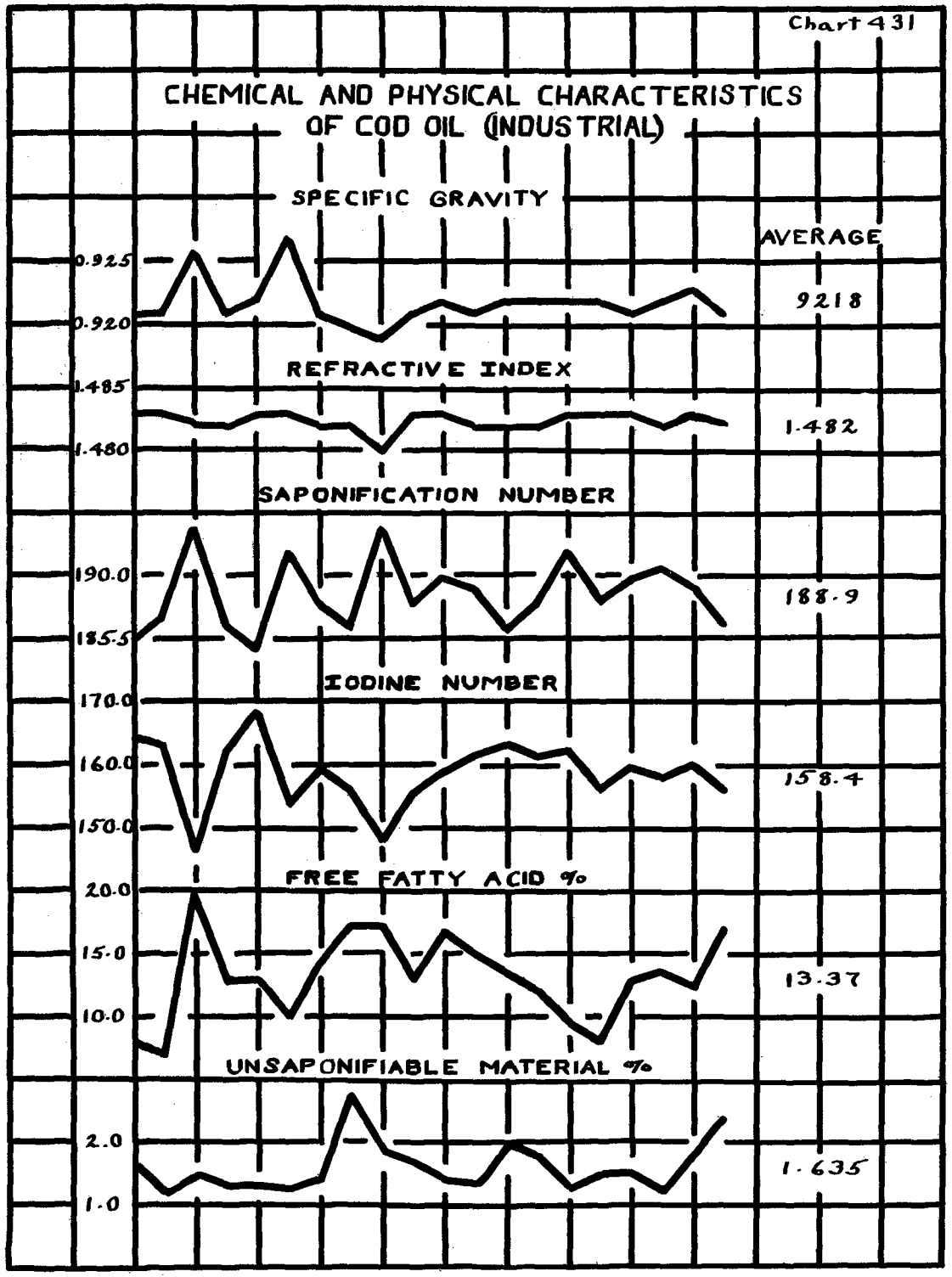
Chart 431
CHEMICAL AND PHYSICAL CHARACTERISTICS
OF COD OIL (INDUSTRIAL)
SPECIFIC GRAVITY
AVERAGE
0.925
0.920
.9218
REFRACTIVE INDEX
1.485
1.480
1.482
SAPONIFICATION NUMBER
190.0
185.5
188.9
IODINE NUMBER
170.0
160.0
150.0
158.4
FREE FATTY ACID %
20.0
15.0
10.0
13.37
UNSAPONIFIABLE MATERIAL %
2.0
1.0
1.635

Chart 431

stance of the skin, and the fatty acids of an easily oxidizable oil such as cod oil. Thus it is evident that there is a definite need for developing standards for cod oil. It is also obvious that the adoption and use of such standards by the trade would serve to stablize the cod oil industry which is now controlled by empirical procedures.

[1] The Chemical and Physical Characteristics of Cod Liver Oil—A. D. Holmes, and W. Z. Clough, Oil & Fat Industries, Vol. IV, No. 12, Dec. 1927.
[2] The Pharmacopeoia of the United States of America. Tenth Decennial Revision. J. B. Lippincott Company, Philadelphia, Pa. pp. 263-264.

TABLE 2
ANALYSES OF COD OIL

Sample Number	Sp. Gr.	Ref. Index	Sapon. Value	Iodine Number	F.F.A. %	Unsapon. Material %	Clouding Point
865	.9210	1.483	185.5	164.5	8.04	1.678	Cloudy at room temperature
866	.9213	1.483	187.8	163.0	7.84	1.217	Cloudy at zero
867	.9256	1.482	194.4	146.3	20.17	1.512	" " zero
868	.9210	1.482	186.2	163.9	13.01	1.348	" " zero
869	.9217	1.483	184.0	168.6	13.18	1.348	" " zero
870	.9266	1.483	194.5	154.1	9.99	1.255	" " zero
871	.9208	1.482	188.0	160.3	14.94	1.485	" " zero
872	.9199	1.482	185.7	156.5	17.46	2.800	" " zero
903	.9193	1.480	194.4	147.7	17.72	1.903	Slightly cloudy at zero
904	.9210	1.483	187.8	156.4	13.25	1.729	Cloudy at zero
905	.9223	1.483	190.2	159.8	17.03	1.404	" " zero
906	.9211	1.482	189.2	162.0	15.36	1.357	" " zero
907	.9219	1.482	185.7	163.8	13.98	2.076	" " zero
895	.9218	1.482	188.0	161.0	12.31	1.782	Cloudy at zero
896	.9224	1.483	192.0	161.7	9.10	1.267	" " zero
897	.9216	1.483	188.2	156.6	7.24	1.530	" " zero
898	.9210	1.483	190.4	159.8	13.05	1.523	" " zero
899	.9221	1.482	190.9	157.6	13.97	1.197	Solid at zero
900	.9230	1.483	189.0	160.1	12.53	1.802	Cloudy at zero
901	.9209	1.482	186.2	153.3	17.36	2.484	" " zero