tallow which showed a titer of nearly 50° C. and an iodine number of less than 30.

It has been suggested to the author by Dr. C. A. Browne of the Bureau of Chemistry and Soils that the difference between these two samples of bear grease may be accounted for on the supposition that the softer grease may have been the product of a young animal while the grease of higher titer and lower iodine number may have been derived from an old bear.

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A Method for Determining Hardness of Fats

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IT IS often of great importance to be able to state the hardness of a fat in concrete figures. Oil mills manufacturing hardened oils receive time and again requests for hardened oils or fats of harder or softer consistency without at the same time lowering or raising the melting point beyond certain limits.

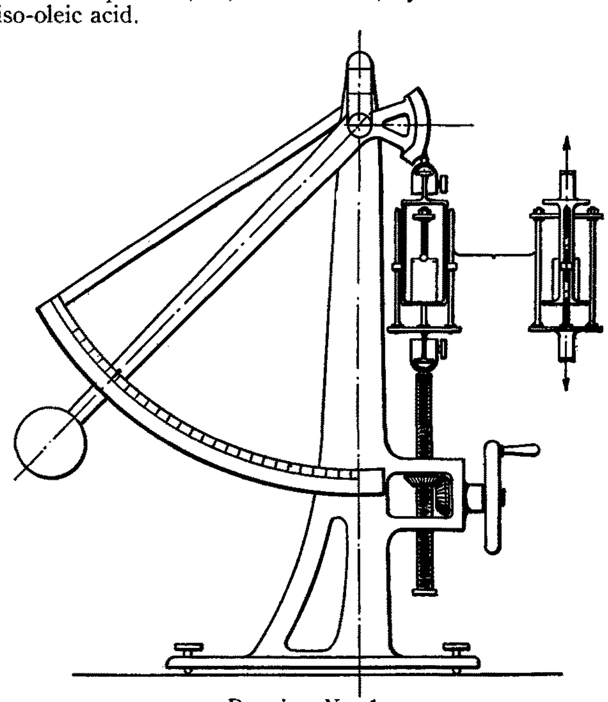
There is no difficulty in conducting the hardening process (the conversion of oleic acid molecules or fatty acid molecules with several double links into stearic acid molecules by introduction of two or more hydrogen atoms) in different ways so that the finished products may have the same iodine number and the same melting point but quite a different consistency (degree of hardness). In the manufacture of margarine a rather hard fat is usually preferred, one that is able to "carry" liquid oils and make a margarine resistant to hot weather. For certain other purposes, for instance, in the manufacture of biscuits, a plastic soft fat is preferable, a fat which stands a thorough working at a rather high temperature without melting.

The difference in the various products can largely be ascribed to the fact that in a soft hardened fat a certain amount of tristearine has been formed from tri-olein while in a harder material, principally monostearic di-oleoglycerides or distearic mono-oleoglycerides are formed, although the condition is really considerably more complicated, as, for instance, by the formation of iso-oleic acid.

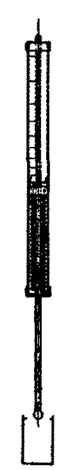
For the determination of the varying degrees of hardness I constructed in 1927 a small instrument (see drawing No. 1) consisting of a metal tube having a metal rod, with a metal ball (a Brinnell Ball) of 10 mm. in diameter, attached at the lower end, inserted in such a way that the rod and ball could move freely up and down thru openings at the top and the bottom of the tube. The rod and the tube were connected by means of a metal spring, this spring being extended when pressure was exerted on the ball. On the rod an indicator was attached, passing thru a slit in the tube. Along the slit in the tube a scale was marked off by holding the tube and pressing the ball against the pan of a scale while placing different weights on the other scale pan. (For practical purposes two instruments were used with springs of different strength.)

The hardness of a fat was then determined by pressing the ball against the fat. As soon as the pressure becomes great enough the indicator remains stationary while the ball passes thru the fat. The point reached by the indicator on the marked scale was then read as the degree of hardness. When the samples are prepared in a definite way as is always necessary when carrying out physical tests, it is possible to obtain quite constant figures with this small instrument.

A few examples will illustrate the difference in hardness of fats which cannot be recognized by any other known physical or chemical test. In the examples given



Drawing No. 1



Drawing No. 2

below the hardness of the fat is marked °K, 1°K corresponding to a pressure of 1 kg. The small figures after °K signify the temperature at which the test is made.

	Iodine Value	Melting Point	Hardness
Peanut oil hardened (No. 52)....	60.2	35.0° C.	17½ °K_{20}
Peanut oil hardened (No. 50)....	61.5	35.1° C.	65 °K_{20}
Peanut oil hardened (No. 34)....	69.0	31.9° C.	6 °K_{10}
Peanut oil hardened (No. 37)....	69.1	27.2° C.	9½ °K_{10}

In spite of the melting point being identical and the iodine value higher, the fat No. 50 is much harder than the fat No. 52.

In spite of a lower melting point but identical iodine value, the fat No. 37 is harder than the fat No. 34.

The peanut oil used for the hardening of the above 4 samples was from the same lot.

The difference in hardness of hydrogenated marine oils is pronounced. The products mentioned below are treated exactly alike, but the hardened whale oil is considerably harder than hardened seal oil.

	Melting Point	Hardness
Whale oil hardened......................	37.0° C.	60 °K_{20}
Seal oil hardened........................	37.0° C.	39 °K_{20}
Whale oil hardened......................	41.3° C.	38 °K_{20}
Seal oil hardened........................	41.4° C.	19 °K_{20}

The determination of the degree of hardness of such materials as lard compounds, margarine, etc., may often be of interest and may be done either after preparing small samples in the manner mentioned below or the tests may be carried on directly on the material, thereby giving valuable knowledge about plasticity of fats cooled in different ways.

The above mentioned instrument is rather primitive and, although not much experience is necessary in the handling, a better construction is desirable. In the laboratory of Aarhus Oil Factory a Schopper's instrument (see drawing No. 2) used for the determination of the breaking strength of yarn was remodeled so as to give a very convenient and practical instrument and this has been used with great satisfaction during the last few years. The original attachment in the Schopper's instrument (see illustration at side of drawing No. 2) was replaced by another attached in such a way that the bottom plate is connected to the clamp above and the rod with the ball is connected to the clamp below. The original pull of the instrument is thereby changed to pressure. The reading is easy and direct on the scale of the instrument and the pressure is carried thru evenly and uniformly. The exact method as now used in the laboratory of Aarhus Oil Factory is as follows:

The fat is melted and cooled down while stirred to a temperature where the fat just starts to crystallize, then poured into small metal beakers and these beakers placed for one hour in ice. Thereafter for two hours in water of exactly the same temperature at which the hardness is to be determined (usually 20° C.). Before the test the upper layer, about 5 mm. of the fat, is scraped off. A beaker with fat is placed on the bottom plate and the ball is pressed slowly into the fat by turning the handle on the Schopper's apparatus 12 revolutions per minute. When the ball has nearly reached the bottom of the beaker the test is finished and the maximum pressure is read on the scale and reported in kilograms (°K) with indication of the temperature at which the test was made. The beakers used are 60 mm. high by 37 mm. in diameter and for practical purposes the edge is equipped with a small 2 mm. broad ring which prevents particularly hard fats from cracking.

An Error of Omission

An article, "Effect of Salt Upon Oil Spoilage in Emulsions," by Lowell B. Kilgore, was published in the April issue of Oil and Soap on pages 72 and 73. The two drawings mentioned on page 73 showing the results from the data presented in Table II were not included, and in their places two paragraphs of extraneous matter were inserted. The publishers regret this unfortunate occurrence and are reproducing the drawings below.

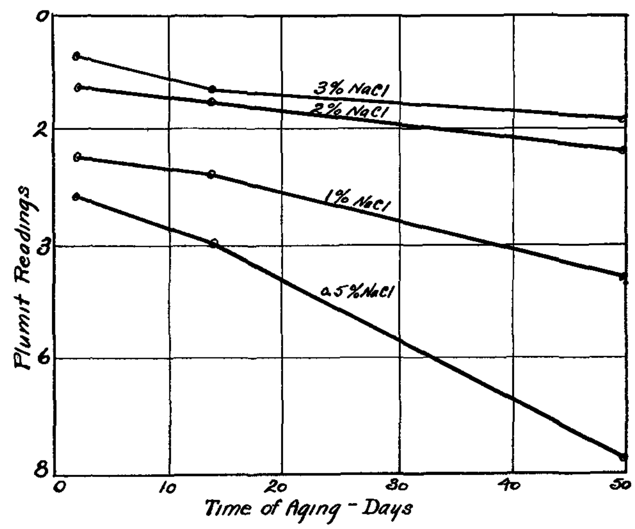


Fig. I.
Effect of Salt Upon the Initial and Storage Consistencies of Mayonnaise.

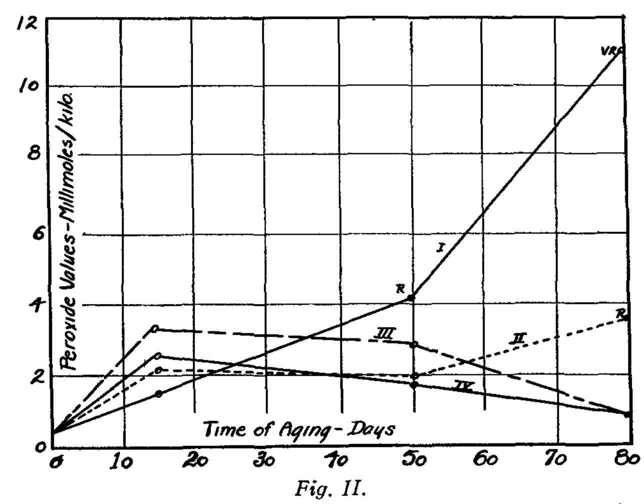


Fig. II.
Effect of Salt Concentration Upon the Formation of Peroxide in Cottonseed Oil When Aged in Simple Emulsions at Room Temperature and Diffuse Light.