two distinct lines. In some experiments known amounts of carbolic acid have been added to raw Ohio River water and the rate of disappearance of the phenol has been determined when the water was stored at ordinary temperatures. In other experiments, in conjunction with H. W. Streeter, sanitary engineer, U. S. Public Health Service, relatively large amounts (100 parts per billion) of phenols have been added to the influent raw water of the experimental water purification plant located on the laboratory ground at Cincinnati, Ohio. Samples were then collected of both the filtered and disinfected effluents over a period of several days, and these samples were tested for phenols. The total amount of water treated in this experiment was approximately 60,000 gallons.

In all of this preliminary work a remarkable reduction has been noted in the amount of phenol originally present as indicated by the Gibbs method. The rate of disappearance of the phenol is too great to permit of a biological explanation. Thus, 100 parts per billion of phenol will practically disappear from raw Ohio River water in one hour. The effect noted must be ascribed either to some peculiarity of the reagent or else to some chemical reaction with the constituents of the water. Further studies along these lines are now in progress.

Conclusions

In summarizing the work which has thus far been brought to a satisfactory stage of completion, it seems safe to say that, under certain restrictive conditions, the Gibbs method is capable of giving reliable information. Applied to domestic sewage, this procedure indicates the presence of 100 to 500 parts per billion of phenol, depending on the time of collection of the samples. With polluted waters values ranging from 1 to 2 parts per billion have been obtained. A phenolic content of this order of magnitude is sufficient to cause a taste in a chlorinated water, if the water is not subjected to the usual purification processes. In the case of coagulated and filtered waters derived from polluted sources, it will be necessary to make a separate evaluation of various modifying factors before any definite conclusions can be drawn concerning the occurrence in such water supplies of tastes following chlorination which can be referred to substances of sewage origin.

Effect of Age on the Apparent Gain in Weight of Drying-Oil Films[1]

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IT IS a well-established fact that drying oils absorb oxygen and increase the weight of the films when spread in thin layers. The apparent gain in weight does not represent the total weight of oxygen absorbed. The absorption of oxygen is accompanied by a chemical change which decomposes the oil film and causes volatile products to be given off. A series of tests has been made for the purpose of comparing some of their physical properties of several drying oils and their apparent gain in weight during aging. Since these experiments do not attempt to measure the volatile loss of the oil films during aging, our results are expressed as the apparent gain per cent in weight of the original oil films.

Experimental

Linseed (raw, boiled, and oxidized), raw China wood, raw perilla, refined soy bean, and refined fish oils were used in the aging tests. The boiled linseed oil was prepared by the incorporation of lead and manganese driers during heat treatment. The oxidized linseed oil was prepared by blowing air through the oil during heat treatment. The other oils were used in the commercial form without further processing. All the oils passed the regular laboratory tests for purity.

The oils were spread on etched glass plates (7.5 by 15 cm.) with a camel's-hair brush. One coat of oil was brushed on each glass plate. The glass plates were placed horizontally in a glass-covered box. There was free circulation of air at all times and films were exposed to indoor light with ordinary laboratory heat and humidity conditions during a period of 6½ years. Table I records the weight of each film and the apparent gain per cent in weight of the films at intervals during the aging period.

[1] Presented under the title "Effect of Indirect Sunlight Exposure on the Change in Weight of Drying-Oil Films" before the Division of Paint and Varnish Chemistry at the 76th Meeting of the American Chemical Society, Swampscott, Mass., September 10 to 14, 1928.

Table I—Apparent Gain Per Cent in Weight of Drying-Oil Films

Time of Exposure	Raw Linseed	Boiled Linseed	Oxidized Linseed	Raw China Wood	Raw Perilla	Refined Soy Bean	Refined Fish
Wt. of film, grams	0.2200	0.1970	0.4000	0.2100	0.2120	0.2480	0.1770
Days	%	%	%	%	%	%	%
1	0.0	12.5	1.7	1.0	0.5	0.5	1.2
3	3.0	11.0	6.5	9.0	14.0	4.0	13.0
4	8.2	10.0	7.2	13.0	15.0	8.0	14.0
6	12.7	9.5	8.0	14.0	14.0	10.5	14.0
7	15.0	..	8.0	..	..	11.3	..
10	15.0	9.0	7.5	13.0	..	11.0	13.0
29	13.0	8.0	6.2	9.0	9.5	10.0	13.0
60	9.5	7.0	5.0	6.5	8.5	8.0	12.0
120	9.0	6.5	5.0	1.6	8.0	5.0	11.0
300	9.0	2.0	4.0	1.6	8.0	5.0	11.0
6½ years	8.8	2.0	3.6	1.5	8.0	5.0	8.3
Condition of films at end of 6½ years	Slightly soft and tacky	Slightly soft and tacky	Least soft of films	Very soft and tacky	Soft and tacky	Very soft and tacky	Very soft and tacky

Physical Condition of Films

The oil films remained fairly firm during the first 29 days. The soy bean and fish oils were less firm than the other oils. All films showed evidence of a slight oil tackiness during this period, the boiled linseed oil showing the least. All the films increased in tackiness and softness as the aging continued. The greatest increase in tackiness was between 60 and 120 days. Observations were made as to tackiness and softness between the 300-day and 6½-year periods, but no record of the results was retained.

At the end of 6½ years China wood, soy bean, and fish oils were very tacky and soft enough to flow. The perilla oil film was less soft and tacky, but was sticky to the touch. No general difference was observed between the appearance of raw and boiled linseed-oil films; both were fairly soft and tacky. The oxidized linseed-oil film was the least soft and tacky of all the films.

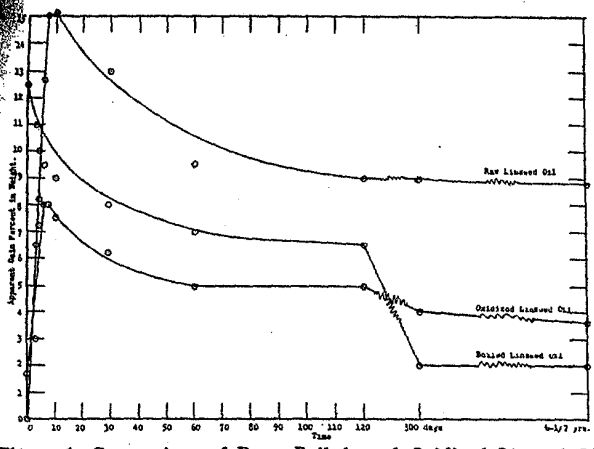

Figure 1—Comparison of Raw, Boiled, and Oxidized Linseed Oil Curves during Aging

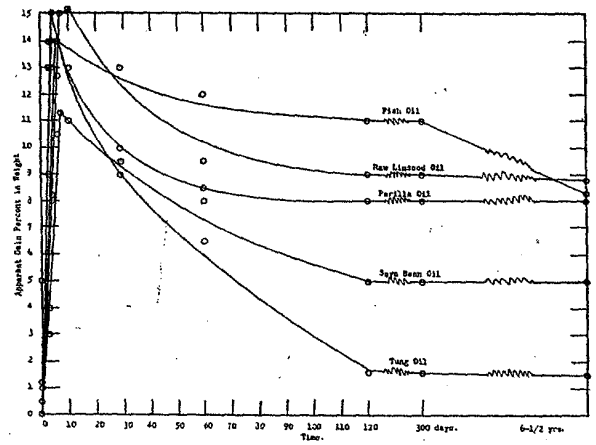

Figure 2—Comparison of Fish, Raw Linseed, Perilla, Soy Bean, and Tung Oil Curves during Aging

Apparent Gain Per Cent in Weight of Films

The curves in Figure 1 show the comparison of raw, boiled, and oxidized linseed oil.. The effect of the driers (manganese and lead) in the boiled oil on the downward slope of the curve is very evident. The greatest change over the raw linseed-oil curve is observed after 120 days. The raw linseed-oil film holds a fairly straight line after the 120th day, while boiled linseed-oil film falls rapidly between 120 and 300 days, and remains a fairly straight line between the 300th day and $6^1/_2$ years. The oxidized linseed-oil film has the least maximum apparent gain per cent of any of the oils in the series. The downward slope also is very regular and the least of any of the oils in the series.

The curves in Figure 2 show the comparison of China wood, linseed, perilla, soy bean, and fish oils. The apparent maximum gain and downward slope of linseed- and perilla-oil films are very similar; the perilla-oil film reaches the maximum gain slightly earlier than the linseed oil. The fish-oil film does not reach so high a maximum as linseed or perilla oils, but the downward slope is very much more gradual until the 300th day, when the curve drops between the values of the linseed and fish oils. The curve for the soy bean-oil film is different from that for other oils. The maximum is fairly low and the downward curve is steep until the 120th day, when the gain becomes a straight line. The China-wood-oil film has a high maximum gain, and the downward curve reaches the lowest level of the oils in the series.

Vitamins in Canned Foods

VII—Effect of Storage on Vitamin Value of Canned Spinach[1]

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THE effect of canning on the vitamin value of spinach was reported in detail in 1925.[2] Samples from the pack made in the spring of 1923 and tested in 1923–24 were at the time set aside for future study to determine the effect of storage. This retest was made in the period May to September, 1926. The results are reassuring in showing little deterioration in vitamin content even after three years' storage.

Method of Pack

Spinach was cut in the morning and mechanically washed on the afternoon of the same day. It was then blanched 2 minutes with hot water and packed in No. $2^1/_2$ cans, brine added, and the cans run through the sealing machine. The sealed cans were then placed in a commercial retort and processed 120 minutes at 240° F. (115.6° C.) (The 2-minute blanch is regular canning practice but the regular process is only 70 minutes. This lot was processed longer to study the effect of the heat on the vitamins.)

Vitamin Values in 1924 and after Three Years' Storage

Vitamin C—Four grams daily were given as safe protective dosage for guinea pigs against scurvy in 1923–24. Retest of stored cans showed 4 grams still protective in 1926 and little significant difference in growth stimulation effect. (Average in 1924, 194 grams in 90 days and in 1926, 154 grams.) Scorbutic symptoms were absent in both tests.

Vitamin A—In the first test 40 to 50 grams gain in 60 days was reported on the Sherman vitamin A testing method using rats cleared of vitamin A. In 1926 the same dosage (26 mg. daily) was found to produce an average of 52 grams gain in the same period. Hence there was no detectable loss in vitamin A.

Vitamin B—In 1923–24 nothing was known of the existence of two kinds of vitamin B, one much more heat labile than the other. It is now known that the cooking of spinach destroys a considerable percentage of its B-1 value (B-1 designates the antineuritic factor, Sherman's F) in which it is much poorer than in B-2 (B-2 designates the antipellagric factor, Sherman's G and Goldberger's P-P). Since no data were obtained on the distribution of these factors in 1923–24, comparisons are impossible. In the light of our present knowledge, however, cooked or canned spinach must be regarded as relatively richer in the antipellagric vitamin than in the antineuritic factor.

[1] Received January 30, 1929.

[2] Eddy, Kohman, and Carlsson, Ind. Eng. Chem., 17, 69 (1925).