The Influence Of Bleaching Adsorbents On The Stability Of Edible Oils

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Abstract

In order to provide oils light in color and free of objectionable odor, it is generally necessary to process them with various adsorbents such as fuller's earth, activated clay, and activated carbon. While this treatment furnishes a more desirable product in keeping with the taste of the American public, unfortunately, it sometimes results in leaving the oil more susceptible to the development of rancidity later on. This work is a study of the effect of various adsorbents, and while it does not provide any final conclusions, it does indicate that the resulting rancidity can be controlled to a large extent by the selection of the proper adsorbent.

Edible oils to be palatable and salable must be light in color and of good flavor and odor. Three processes, refining, bleaching, and deodorization are employed to meet these requirements. These processes are frequently believed to lower the resistance of the oil to deteriorative oxidation and subsequent rancidity. It is generally accepted that a crude vegetable oil is more stable than the corresponding refined oil. During caustic refining, natural anti-oxidants existing in the crude oil (such as phosphatides) are removed, thus lowering the resistance of the oil to oxidation. During the bleaching operation, the pigments, e.g., carotene, chlorophyll, xanthophyll, are removed; it is generally believed that these too have definite anti-oxidant properties, although conflicting data has been found on this.

There are essentially three classes of adsorbents used in bleaching vegetable oils; namely, natural earths, activated earths, and activated carbons. For economic maximum bleach a carbon-earth mixture is generally employed, the ratio of carbon to earth depending on the type of oil. The chief factors influencing the oil refiner in choosing the type of adsorbent have been a maximum bleach and a minimum oil retention. It is only in recent years that attention has been given to stabilizing vegetable and especially animal oils. Although refined bleached vegetable oils do not oxidize readily to the rancid point, they do oxidize quite readily to a point of color reversion. The oil refiner must be careful that his choice of adsorbent does not accelerate this, for an oil loses its salability when it darkens.

The scope of our work was to bleach cottonseed oil with various concentrations of different adsorbents and then chart the quality of the oil by chemical and physical tests through an induction period. We have not been able to find a limiting definition of induction period, but we understand it to be the period of time under which an oil is maintained under controlled conditions up through the point of definite rancidity. The first step was the selection of one of the methods that have been devised for accelerated oxidation of edible oils. For our purposes the incubation oven method similar to that of

NOTES

President Sheely has named Messrs. E. C. Ainslie, W. D. Hutchins, and A. A. Robinson as members of the Nominating Committee. Mr. Ainslie will act as Chairman.

The banquet and dance at the Southern Yacht Club on Friday evening promises to be more delightful than ever. Music will be supplied by Leslie George's Orchestra, well-known New Orleans musicians.
Schaal was found the best for, although slow, it gave more consistent checks than we were able to obtain with the more accelerated tests. By this method, a small sample of oil is placed in a beaker exposing a great surface of the oil to atmospheric oxidation. The beakers are then placed in a ventilated incubator at 60°C and withdrawn when desired for testing.

The next step was the selection of a method of measuring the amount of oxidation. Oxidation in the oil molecule has been found to be accompanied by an increase in free fatty acid content. Substances such as ethers, ketones, lactones, aldehydes are formed first; on further oxidation free fatty acids are formed. An F.F.A. test might give an indication of oxidation, but this is not necessarily so, for, when moisture is present, it may cause hydrolysis of the glyceride, giving rise to an increase in free fatty acid content. Therefore, this test is of little value as a quantitative measure of oxidation.

Wheeler, who has done much work on the stability of cottonseed oil, has shown that as the oil oxidizes the iodine value drops. It is believed that during the oxidation, the double bonds being saturated with oxygen break down, resulting in a drop in iodine value. However, the iodine value does not drop at a rate corresponding to the increase in oxygen absorption.

The Kreis Test has been employed by oil refiners for many years as a means of checking the quality of an oil. When a 1% solution of ethereal phloroglucinol is added to an oil-concentrated hydrochloric acid mixture, a pink to red color develops depending on the extent of the supposed oxidation of said oil. (The theory is that this red color is formed by the action of phloroglucinol of epihydrin aldehyde which is usually associated with the presence of heptylic aldehyde in the oil. This heptylic aldehyde is known to have a vile smell and supposedly causes the rancid odor.) However, it has been shown that this test becomes positive long before organoleptic rancidity appears. We would emphasize that we are not condemning the Kreis Test, for it serves the purpose of giving the oil refiner an indication as to the quality of his oil.

The "Peroxide Value" gives a quantitative measure of oxidation up through the point of organoleptic rancidity. In this test the loosley held oxygen taken up at the double bond linkages liberates iodine from potassium iodide. Although satisfactory for measuring oxidation, this test does not denote the point of organoleptic rancidity. This is because the amount of oxygen required to develop rancidity depends on the type of oil. As an example, lard, to become organoleptically rancid does not need to take on nearly as much oxygen as cottonseed oil. Also the rate of oxidation is not the same. For these reasons only one type of oil, namely, cottonseed, was studied. (As is well known, the course of oxidation is affected by accelerants making it necessary to make definite control of these items, i.e., heat, light, moisture, certain metals.)

It is apparent that the peroxide test is far from being an ideal test for the measurement of rancidity. However, as it appears to be the best one yet devised, it was used in our work as a basic measure of oxidation, supplementing it with the occasional use of the other tests mentioned.

Before attempting to compare the various adsorbents on the rate of oxidation, it was decided to take a bleached oil and run it through a complete induction period and to compare our results with those in the literature.

Figure 2 illustrates the course of oxidation of our work as measured by color and peroxide value compared with those of Wheeler (Figure 1). In our search through the literature we did not find any great certainty as to the exact course of the oxidation of the molecule, particularly through the early stages. We believe that an examination of the curve brings out certain significant features. Let us consider briefly the theory of what happens when an oil be-