Olive Oil Adulteration and the Analyst

By M. F. LAURO

ONE increasingly difficult problem confronting the analytical chemist of today is the ready detection of adulteration. With olive oil, which has been called the oil par excellence, this is especially so, as the conventional analysis is seldom of any great help in the majority of cases. The adulterator is far ahead of the analyst, with whose researchesh e keeps in constant touch in order to devise new means of circumventing him. Instead of a single oil, or such oils as are easily detectable, he makes a mixture of several, generally those for which the chemist has no specific reactions, in just the proportions to come well within the values given for pure olive oil and thus defy discovery. His task is not so hard as it may appear, since these values spread over so wide a range and are so ill-defined by text and authority that quite a list of oils is available for such mixing.

What is Olive Oil?

This leads one to pause to consider, "What is olive oil? What makes it differ from other oils? What is there about it that makes it cost so much more than the others?" The answer to these artless questions involves the survey of olive oil from three angles. The consumer of the edible grade regards it from the superficial and patent, the chemist from the intrinsic and latent point of view, and the technical user from the way it behaves in practice. The characteristic properties of pure olive oil cannot be resolved into a single test for identification. It is not the same thing to all men.

Produced in a variety of kind and grade to fit certain purposes, nevertheless, olive oil—pure olive oil—has a distinct superiority over other oils whenever so used, such as to characterize it apart and subject it to more extensive imitation and substitution than any other vegetable oil. Not that there are uses to which any other oil may not be better adapted, as in deep-fat frying shortening and mayonnaise. But for certain soaps—as Castile, mottled, and textile; for sulphonating purposes; and as a salad oil, olive oil commands a premium, as evidenced by its higher price.

It is, however, in the edible line that this oil is prized so highly that one wonders as to the reason why. There are those who care naught for the flavor of olives. It is like caviar to the millions. But for those—and there are many—who delight in its fruity flavor, olive oil is worth the extra cost. Undoubtedly the lay public buys this oil primarily for flavor and incidental medicinal properties. If the present trend in the manufacture, preparation, and blending of olive oil continues, however, to say nothing of the extensive evil of mixing in other oils, what little there is left of these two characteristic qualities plainly justifies no premium over other edible oils.

The Change in Olive Oil Quality

Were we to refine and deodorize olive oil, in so far as the consumer is concerned, we have taken out all that he pays for. To him, all refined, deodorized edible oils look and taste alike, whether peanut, cottonseed, corn, sesame, or olive. They represent simply fatty matter. Whatever differences due to chemical and physical composition may exist innately between them are certainly too slight to warrant any appreciable price differential.

Now, as a matter of fact, this is just what is going on at the present time. A great change has come over olive oil quality within recent years. It is doubtful whether there is olive oil on the market in the United States today with the old-time full fruity olive flavor and therapeutic quality. Perhaps people here like a tasteless oil. If so, then other oils would answer the same purposes and there is no especial need for olive oil. And surely, one should not be required to pay the higher price.

Oil and soap chemists are urged to send to the editorial offices of Oil & Soap photographs of their laboratories and plant equipment.

Olive oils that normally find their way into edible lines are refined, bleached, and deodorized to blend with harsher oils of inferior quality, making up the usual edible olive oil sold today. This is regarded as sophistication and presents an unusually hard problem for the chemist of today. Oil recovered from foots, a by-product of the olive oil manufacture, extracted from the residual pulp with carbon bisulphide, de-acidified, bleached to remove the green color and steamed to remove objectionable odor and traces of solvent, is now a common ingredient of salad oils. In many cases, artificial olive flavoring is added. There is a green olive oil prepared from foots or inferior olive oil, colored with chlorophyll, copper compounds, or dye, for mixing with cottonseed or other oil to simulate olive oil.

Even as to pure olive oil, accustomed as time goes on to a bland and almost tasteless salad oil, the American public is being deceived, since it pays a very high price for oil attenuated, if not entirely deprived of those virtues possessed only by virgin olive oil or oil of the first pressing with no treatment other than necessary for clarifying.

The Three Approaches to the Identity of Olive Oil

Flavor, then, represents as to the edible oil, one way to distinguish olive from other oils as well as the choicer grades of the same. It is for the expert to pass on, and unfortunately there are very few analysts who include this most valuable index to purity and quality in their routine analysis.

Of course, it is of small consequence in the case of commercial oils where the odor has been masked with denaturing substances like oil of rosemary, as is usually the case. Yet heating often brings out the odor of olive, or of such oils as lard and fish when present as adulterants. And so, the chemist should include this simple test in his search for impurity, however slight its value may appear.

In the inedible line, for certain purposes, olive oil still holds a superior status. It has undoubted advantages as a soap, in cosmetics, in the textile industry and in sulphonation. Why? Because of its peculiar properties and behavior when applied in the arts. This constitutes a second distinguishing feature. As an example, a greater thermal effect than usual in sulphonating an allegedly pure olive oil was the clue that led to the discovery of a foreign oil. This would suggest the Maumené number to the chemist, a test usually of no value and rarely applied. The addition of corn or peanut fatty acids to olive oil foots is said to alter its behavior in saponification and the resulting soap color to a degree capable of detection.

Correlated to this method of detecting abnormality, and as a third element of differentiation, there are the characteristics developed by chemical analysis. Thus olive oil is tested for its iodine absorption or acetyl value, its composition in terms of fatty acids, saturated and unsaturated, its reaction to various chemicals and its properties as manifested under certain tests.

In considering these three ways by which this oil is judged, i.e., the consumer's, the user's, and the chemist's, a better idea of what is olive oil can be obtained than by each separately. For this reason, the chemist should include in his routine of analysis, organoleptic tests and any practical method corresponding to a particular application in the industry.

Limitations of the Commercial Analysis of Olive Oil

The commercial chemist is restricted in the analysis of oil to what his client will pay for. Hence, in the course of time, he has evolved a set form of procedure in determining the purity from which he varies but little: specific gravity, iodine, saponification and acid values, a few color or qualitative reactions, and occasionally an index of refraction, unsaponifiable matter, etc.

It happens there is no specific test for olive as there is for sesame and cottonseed oils. The evidentiary tests are really exclusive and negative ones, not direct and positive. Purity is judged by freedom from such oils as do have special traits, or by departure from normal values. Now, what are the normal values for olive oil? They vary with the source of the oil, its locality, mode of preparation, etc. One need only glance at the limits given by text and authority to stand convinced that ten and twenty percent of other oils may be mixed with olive oil before any change occurs to give definite evidence of abnormality. In some cases, in oil denatured for edible purposes up to 100 percent adulteration may be had with

scant hope of detection. Teaseed oil is one of those oils that so closely resembles olive as to practically defy discovery.

Of course, the more values sought, the greater the chance of finding anything wrong. This very often means considerable work for the chemist for which he is grossly underpaid. From the outsider's point of view, however, the cost of a complete analysis is prohibitive save in exceptional cases. Furthermore, his inquiry is a simple one and he cannot understand why the chemist must do so much work to answer that. "The trouble with analytical chemistry," thinks he, "is the vast amount of labor involved in finding out the simplest thing!" To a large extent, he is right. It is also true that some of this labor is by nature inevitable. Yet the analyst is woefully behind the physicist in the use of modern tools. He concerns himself rather with standardizing methods of analysis for official work than with developing short cuts for himself, using the new knowledge acquired since 1900 in allied lines, as in modern advanced physics and electricity, which have furnished the mechanical and esthetic improvements of recent years. There has been a revamping of science in the last twenty years with consequences far greater than have been produced in all the years of mankind before. Yet analytical chemistry has changed very little. More tests have been added from time to time, but it seems chiefly to have made some very simple tests more elaborate and cumbersome, so much have they been hedged about with safeguards.

The pioneer necessarily sought all the items by which he could identify, determine and grade kind and quality. Those that followed in his footsteps continued the practice of using his criteria. Now, stereotyped for posterity they have become a burdensome overhead to the commercial chemist, by reason of their great number and lengthy procedures.

Today, the trade cannot wait for the chemist nor can it pay the commercial analyst the price of a long laborious test. It is up to the chemist to catch up. The depression has developed the three and five dollar analysis or no analysis at all. It is only when trouble arises as in breaches of contract or disputes as to quality, that a more extensive examination is required.

This may seem to the old-timer a degrading of the profession. If one is in business for a living, he must adapt his methods to the times, in order to succeed. He cannot use the ways of one who is subsidized and under no press of time. Official methods are for official work, though even there, brevity of procedure would be desirable. To hew to the orthodox analysis which the pioneer fastened upon him and which has been rendered useless by advancing years of adulterating and changing quality means fewer and fewer calls for the chemist from the merchant, who is always in a hurry and cannot pay much. To proceed on the old factual basis, getting all the data possible whether necessary or not, may be a proper function of the scientist in building up a literature on the subject. It is not for the practicing chemist to follow the course laid out by one with a distinctly different objective or by one, who with good intent, accustomed the trade of his day to a comprehensive type of report, which some still feel makes a formidable and convincing array of facts.

Many of the usual items of analysis might well be omitted. Subsequent events have made them useless. Of such are specific gravity and index of refraction in the case of most oils. For olive oil, about the only material constant left is the iodine value. This leaves very little to show on a certificate of analysis, but it is a good policy not to report unnecessary tests, even if run, lest a precedent of Frankenstein proportion be raised the next time an analysis is requested.

The Need for Specific Tests

Since most of the so-called characteristics of oils have outlived their usefulness in those cases where a price difference induces an extensive imitation or substitution with other oils (where even the iodine value can furnish no help), any trait that is possessed by one oil and none other offers the best possible proof of purity. Unfortunately only a very few oils have been found at the present time to have such special traits. They may be evidenced by a color test or by some particular fatty acid or by some peculiar behavior. Cottonseed, peanut, rape, and sesame oils are examples. For olive no special test has as yet been discovered. Research is therefore needed to develop these most useful criteria of purity. The men best qualified by reason of their varied and continuous practical experience with oils have seldom time to carry on any experimental work; hence tests of this kind have been slow in coming. Extensive changes in the mode of preparing many oils have rendered obsolete color tests that were well thought of years ago, since these color reactions were doubtless due to impurities in the oils that are no longer there. The Halphen for cottonseed and the Villavecchia or Baudouin for sesame are examples of those that have survived and show clearly the advantage of such tests in the determination of purity. Every endeavor should be made to add to the list, since they afford a better means of detecting adulteration than some so-called constant which measures a property in common with other oils like the iodine or alkali absorption capacity, differing only in degree, and therefore easy to duplicate.

The Need for Revised Data

Pending the discovery of special tests and new characteristics, the old ground should be cleaned of much that impedes the growth of new ideas. In the first place, a great deal of the data carried along in the literature was obtained on oils under different conditions of manufacture and preparation than the present, by methods of analysis more or less accurate and some practically obsolete. A good many of the iodine values were obtained on cruder oils than appear on the market today, by the old Hübl method, which registers figures considerably below those of the Hanus and Wijs methods. The September, 1933 issue of "Oil and Soap" contained a timely article by J. T. Andrews on the "Saponification Number of Cocoanut Fatty Acids," in which he showed how untrustworthy was the value given in the literature for the mixed fatty acids, and how this error became perpetuated in the standard references, without any question being raised at any time. The older literature contains many instances like the above that repeated revisions have not weeded out. There is urgent need of revising the values to conform to more modern practice.

Commercial laboratories and those connected with the large industries have been analyzing all varieties and grades of oils for many years, keeping pace with the market and thus with changes in quality. A compilation of the data from these sources would prove most useful information on which to base a proper evaluation of oils as they actually appear on the market—as merchandise, in bulk, for general sale and consumption, not as laboratory samples or experimental products. Thousands of samples of oils have been tested by the commercial analyst to the few hundred examined by the chemists who have helped make the literature of the past. Each has his peculiar and necessary function to perform. The latter, we might say, give the "theoretical" values of the pure oils as lights to steer by, but the practicing chemists, in shaping theory to practice, depart somewhat from the wider range thus given and restrict the values in the light of many thousands of examples to those that conform more nearly to the actual. They thus achieve a range representing the fair and usual average quality of the season's production, which, it is submitted, is a truer and fairer index to purity and quality than the text values. Evidence of this statement is seen wherever and whenever a trade association or group of chemists has undertaken the setting up of rules and regulations regarding the purchase and sale of oil. Specifications in such instances are found to accord with trade practice.

The Advantages of Definite Specifications

This leads us to the unquestioned merit of establishing standards of quality for any food product. Left undefined, such a product is at the mercy of the profiteer and the adulterator.

As matters stand now, with the extremely wide range of values reported for olive oil in literature, it is most difficult for the chemist to pass judgment as to its purity. Restricting these values within narrower limits would set up a higher standard of quality which would tend to reduce the evil of adulteration. It is true that extensive mal-practice has caused the "characteristics" of olive oil to mean very little today, leaving the iodine value and a few qualitative tests the only material symbols in the orthodox scheme of analysis, yet in advance of finding new and better and more characteristic traits, about the only recourse we have in the present situation is to draft a new set of specifications covering the various kinds and grades of olive oil and its by-products so that the old ground may be effectively cleared for the newer growth.

To be practical, these specifications must correctly apply to the product we are defining. Yet to be effective, they must represent that product as it appears on the market. The abnormal and the unusual must be left out. This results in giving the trade a permissive standard to aim for, a shield of protection from inferiority and a sword against the evil of debasement.