Sardine Oil Color Standards

Methods of Grading the Several Varieties Dependent Upon Various Factors Affecting the Color Content

By P. W. TOMPKINS*

SINCE the advent of the sardine oil industry on the Pacific Coast, it has been the custom to designate the color as light (pale or straw), or dark, where the contract required this unstandardized grading. The terms light, pale or straw were practically synonymous and represented a wide range of light colored oils as differentiated from dark extracted oils, or oils which have become excessively dark from one cause or another. But just where the range of light color ceased and dark began was often a source of controversy. Light colored fish oils to the paint trade are different from light oils to the edible oil trade, while from the producers' point of view, anything that is not very dark or black is "light." Before considering attempts to create color standards, it must be understood that there is a great variation in the color not only between different kinds of fish oil, but also between the same kind of oil produced in different localities, and even a seasonal difference in oils from the same locality. The conditions of its rendering, regulations of the Fish & Game Commission, and other causes also influence the color.

Herring oil produced in Alaska, where whole fish is employed is quite light and considerably lighter than the average sardine oil produced in California. Pilcards, i.e., sardines caught in Canadian waters off Vancouver Island, are reduced whole for fish oil and meal, and the oil as a whole is slightly lighter than the average run of sardine oil made from a mixture of offal, trimmings and whole fish at Monterey and San Pedro, the principal points of production in California. Salmon and tuna fish oils are also different and derived mostly from trimmings as a by-product of the canning industry, tuna fish oil being almost black and salmon oil "salmon colored" to dirty brown.

The production of sardine oil at Monterey began about 1915, and at San Pedro about 1918. The former now produces about 350 cars per season, the latter about 250. The oil and meal are mostly by-products of the sardine canning industry, and present methods of preparation and handling are better than formerly, and the product more uniform and lighter in color as a whole. As production increased and sardine oil was more in demand for various uses in the the paint and varnish

Boat-loads of sardines ready for discharge at canneries

industry, for certain kinds of soap, and in increasing application for edible purposes as a refined, deodorized and hydrogenated product, the need for color standards became more apparent and controversies more frequent. Laboratories cannot create standards according to their own preference and opinions, but must pass on commodities according to standards or rules mutually adopted by the trade or associations. In the absence of such standards or rules, they attempt to report in terms of prevailing understandings, the conditions as they are supposed to exist. However, trade understandings differ according to the particular needs of those concerned, and the laboratory is usually made the "clearing house" for contentions and is often blamed for not attaining the impossible.

Existing Methods

AS A result of the general dissatisfaction with the old system of color grading of sardine oil shipped from the Pacific Coast, and hoping to help create more or less definite standards, we made specific observations extending over several years. To develop stan-

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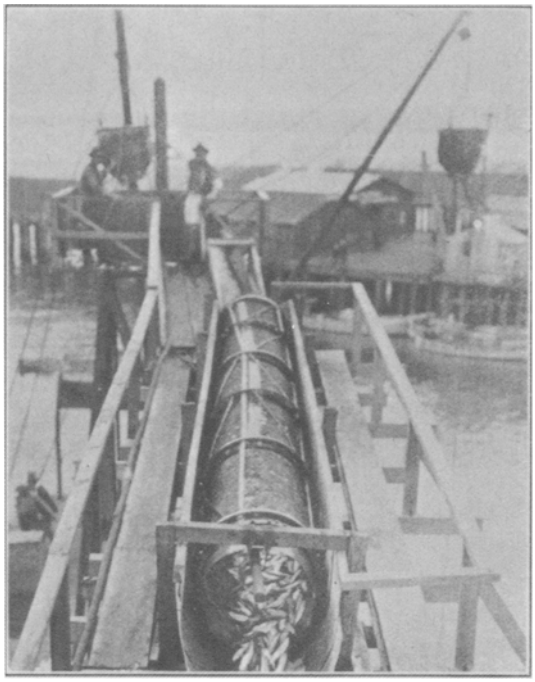
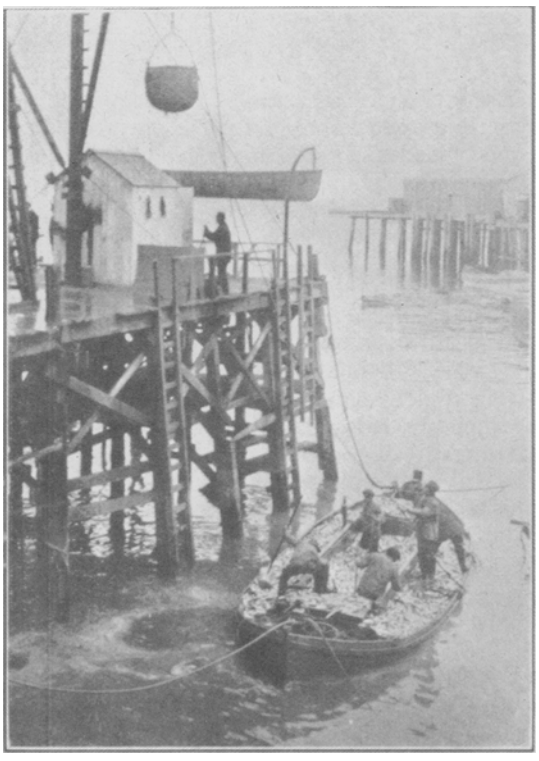
dards that would meet practical conditions of the sardine oil industry at the two points of manufacture (Monterey and San Pedro) and at the same time satisfy the requirements of all concerned was not a simple undertaking. Obviously there cannot be a separate set of standards for Monterey and another for San Pedro products, as both are sardine oils and the Eastern buyer has no way of differentiating between the two sections, yet the two localities produce oils differing widely in color characteristics due to the feeding habits of the fish. There should be one standard which everyone understands and uses, so that all will deal with a definite knowledge of what is to be expected Until the trade as a whole has accepted some basis within which it is willing to trade, no tangible result can be expected. As a result of the investigation, we are more convinced than ever, that it is not practically feasible to set any hair-splitting color standard for this oil, particularly under the conditions of its manufacture. The color is too much affected by the feeding habits of the fish, and in part by the conditions imposed by the Fish & Game Commission, which regulates the amount of material that can be used for oil and meal production. We must also anticipate a variation from season to season as well as between one plant and another.



Fish passing through revolving scaling cylinder



Unloading fish from boat to scaling cylinder

Sardine oil production has developed so fast, that producers have not all adopted standard methods and only a few have any laboratory control over their products. Furthermore, conditions in the fishing industry are so changeable that it is impossible, even with the most improved methods of production, to turn out a uniform oil. At the commencement of the season, fish, in the Monterey district, feed on a sea weed and the chlorophyll gives the oil a distinct green cast in much the same way that offal tallow has a greenish tinge, but this is not an important consideration at San Pedro. Later in the season after spawning, the oil is darker and of amber tint. When the catch is large and greater than the demands of the canning industry, some of the whole fish is used along with the trimmings, or certain amounts of fish alone may be used within the limits prescribed by the Fish and Game Commission, all of which changes the character of the oil even from the same plant. The Commission only allows about 35% of the catch being used as whole fish for oil and meal reduction, the balance (excluding trimmings) must be used for canning. On the basis of

100 tons of fresh fish the disposition would be roughly, as follows: 32.5% Whole fish allowed for oil and meal reduction, 24.0% represents trimmings and offal used for oil and meal reduction, 43.5% represents packed fish.

The technical considerations affecting the establishment of color standards may be reviewed to advantage, as conclusion should be based on a full understanding of the underlying principles which control the sardine oil industry as it practically exists, and not on the basis of an ideal situation and standard which cannot be lived up to. To better understand the foregoing, the following color extremes are given, though there are numerous intermediate shades and color ratios between them. All colors are expressed according to the Lovibond scale.

Range of San Petro Amber Oils*

Yellow	Red	Ratio
100	25.0	4 -1
70	18.0	4 -1
50	14.0	3½-1
50	12.5	4 -1
35	10.0	3½-1
35	7.0	5 -1
30	6.0	5 -1
20	5.0	4 -1

Range of Monterey Amber Oils*

Yellow	Red	Ratio
150	16.0	9 -1
150	12.0	13 -1
100	10.0	10 -1
100	8.0	12 -1
100	7.0	14 -1
100	6.0	17 -1
70	6.0	12 -1
50	5.0	10 -1

Range of Green Cast Monterey Oils*

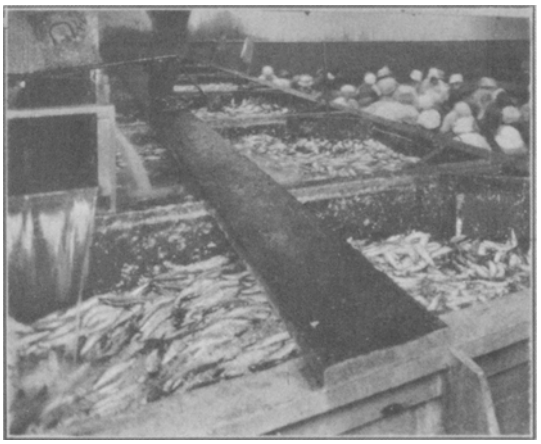
Yellow	Red	Ratio
150	4.7	29 -1
100	4.0	25 -1
100	2.0	50 -1
80	2.0	40 -1
80	2.5	32 -1
70	3.5	20 -1
70	2.5	28 -1
60	2.0	25 -1

*All readings in 1 inch cell.

By mixing an equal proportion of each car of sardine oil examined, the following color averages were obtained and the effect of the numerous greenish oils in the Monterey blends is noticeable. Season 1926/7—Average San Pedro—50 y. 6.6 red—ratio 7½ to 1, Season 1926/7—Average Monterey—50 y. 4.8 red—ratio 10½ to 1, Season 1927/8—Average Monterey—70 y. 5.2 red—ratio 15½ to 1.

Proposed Standards

THE first idea of establishing standards naturally was to be guided by what has been used in the past for similar purposes, and in this the caramel color standards used by the Paint Manufacturers Association and the National Varnish Manufacturers Assn. appeared to be the most promising. The standards are made of caramel solutions of varying but definite color strengths in terms of yellow and red, and the varnish visually compared against these in bottles of like size and sets of these standards are sent to the trade. It was hoped that the caramel solutions could be made to serve as the basis of comparing the sardine oils, possibly in a Union Colorimeter, and by that means to classify the oils according to the standards adopted for the caramel which would act as a quick means of approximate color control for the plants. It was clearly demonstrated, however, that this method would only serve the purpose for certain types of amber oils where the ratio of yellow and red were more or less the same as those of the caramel solutions. The system was found impractical due to extreme color variations and impossibility of making any standard of this kind that would characterize all types of oils produced at Monterey and San Pedro. No standards could be prepared that would serve the purpose for both places and match the greenish as well as the amber oils.



Fish in water tanks in cutting and cleaning room, where the trimmings and offal are obtained for oil and meal

By ordinary comparison, many of these greenish cast oils with low red appear darker than some amber oils with a higher red. For example, a greenish cast oil with 150 yellow and 4.7 red appeared darker than an amber oil of 50.0 yellow and 12.5 red when examined by reflected light. More difficulty was encountered in settling the yellow for these standards. What applied for the amber oils was unworkable for the greenish cast oils. As an attempted remedy, any set yellow was to

be omitted from the standard, and the red alone become the controlling factor. But this scheme also had the disadvantage of not properly controlling the classification of the green oils where only 2-4 red is required in matching colors. As the effort to practically use caramel standards as a means of grading Pacific Coast sardine oils as a whole was discouraging, we looked to the system originally worked by F. A. Wertz, where potassium bichromate in sulphuric acid was used as the basis of color designation of varnishes. This solution, however, has the disadvantage of not keeping very well and hence for an original or secondary standard, caramel would be better if it was usable at all for this purpose. Besides the unstable keeping quality of the chromate solution, it had the same disadvantage as the caramel of not being able to accommodate the great extremes of color.

As a further attempt in this direction, iodine in potassium iodide and water as used for color grading in British specifications for raw linseed oil was tried out, but with no more success than with the former systems. The iodine solution like the caramel and bichromate, could not be made to accommodate such a complex color range as exists. While all three methods answered the purpose for a certain range of colors, the caramel was most adaptable to amber oils around 10 red, but those of the greenish cast were entirely out of range. In other words, a caramel solution built up to 10 red (35 yellow) in a 1" cell, would fairly correspond to the color of an amber sardine oil of 10 red (50 to 100 yellow). Sardine oils of this color range and cast could be graded fairly closely against a caramel solution of the above strength, providing the comparison was made by transmitted light as if in a colorimeter.

By various means of observation, oil colors differ greatly. Attempts at visual comparison by reflected light, of oils which had been standardized by transmitted light gave entirely unreliable results, especially when attempting to grade the greenish oils. It was found unsatisfactory to attempt comparisons by other than pure transmitted light. The thought of being able to give the producer standards with which he could simply compare his products for guidance at the plant was quite upset on this account. The experiments with artificial color standards was finally given up and as a substitute the sardine oil itself was considered for the purpose. As the caramel or other artificial standards were primarily to be based on some stated Lovibond color, it seemed only natural and more direct to apply the color limitations to the oil itself. While it was quite feasible to arrange standards in this way for the amber oils, it was just as difficult to make them fit the greenish oils as the artificial standards. This latest obstacle was to be overcome by having one set of standards for the amber oils and another for the greenish oils, but here more trouble was ahead. The trade did not want so many standards, they desired two only that would do for all oils at both points of production. One to limit the "light" or "pale" as distinguished from "medium", and a "medium" standard to differentiate between "medium" and "dark" oils.

Other phases of this investigation had to do with the preparation of the oils for observation. They contain more or less moisture and insoluble impurities and considerable stearine. The stearine deposit varies according to temperatures. How rapidly could the sample be rendered in suitable condition for observation? Should the readings be made after removing the stearine or the oil heated till the stearine went into solution and the reading then taken? Could the introduction of blue glasses be agreed upon, etc.? Many like considerations had to be reviewed, discussed and answered. Briefly it was found that the color reading was not practically affected by the removal of the stearine which was best eliminated by filtration at the ordinary room temperatures, which also removed the insoluble impurities and interfering moisture, if the moisture was not too high. In a few cases of high moisture (free water) the filtered oil, not being clear, had to be centrifuged or heated. To heat the oil before filtration to remove water darkens the oil on account of the presence of the insoluble impurities (fish meal). If the filtered oil stood too long at a lower temperature than when filtered, a further slight deposit of stearine sometimes took place. In such cases it was only necessary to warm the oil a little or refilter it when a perfectly clear liquid was again obtained for reading.

In conclusion, the whole subject has resolved itself into; how could two standards based on 8, 10, 14 or 16 red be made to control the greenish oils with only 2 to 4 red and 60 to 150 yellow, to say nothing of all the intermediate shades. Here is where the subject stands today, unanswered and little discussed. To have some definite point of distinction, any sardine oil not exceeding 14 red (yellow to match) is graded as "light", and above 14 red "dark". This custom has been followed for the past three seasons for Monterey and San Pedro products and in effect is practically what has been followed from the beginning of the industry.