alcohol and again evaporate to dryness. Dry to constant weight at 80° C. Weight of residue multiplied by 100 gives the per cent of resin in the drug.

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PERMANENT COLOR STANDARDS FOR U. S. P. COD LIVER OIL, ALMOND OIL AND CASTOR OIL.*

BY ABRAHAM TAUB.

The need for the more definite specification of color for certain U. S. P. oils has been frequently pointed out both by manufacturers and food and drug enforcement officials. To describe an oil as pale yellow in the U. S. P. monograph may lead to several ambiguous interpretations. It may imply that a colorless oil would not meet the U. S. P. requirements; or it may leave the observer in doubt as to whether the oil in question is slightly darker than pale yellow. Furthermore, the term pale yellow does not distinguish between greenish yellow and reddish yellow. Only a quantitative standard can obviate this condition.

While there are many instruments on the market for the specification of color, it is felt that a simple and inexpensive method would be more desirable for most laboratories. It is the purpose of this paper to set up permanent color standards for these oils by using the Arny "Co–Fe–Cu" inorganic colored fluids. The colors exhibited by the U. S. P. oils which were studied, required the use of only two of these inorganic fluids to produce proper matches—the $M/4$ $CoCl_2 \cdot 6H_2O$ and the $M/6$ $FeCl_3 \cdot 6H_2O$, both acidulated with 1% HCl to prevent hydrolysis and insure permanent stability.

For checking the closeness of the match, a Bausch & Lomb spectrophotometer was used. A number of the "Co–Fe" blends were made up which closely approximated the color of the oil being studied, and the particular blend whose spectrophotometric curve most nearly coincided with the spectrophotometric curve of the oil was adopted. The reason for using this instrument rather than a colorimeter or tintometer was to produce a match which would not appear different under different light conditions. It has been definitely shown that two liquids whose spectral transmission curves are alike will appear the same under different conditions of light; this is not necessarily true for two liquids which give the

* Scientific Section, A. PH. A., Toronto meeting, 1932.

same colorimeter readings. In this particular study it was not possible to get exact coincidences of transmission curves due to inherent differences in the light transmissions of oils and these salt solutions. They were sufficiently close, however, to be of practical use for preparing these color standards.

All the liquids were examined spectrophotometrically in 100-mm. tubes. For actual matching by the eye, the oils and the "Co–Fe" solutions were examined in 4-ounce, tall, cylindrical, oil-sample bottles. These measure 35 mm. outside diameter and 135 mm. from shoulder to base.

I. COD LIVER OIL.

The Pharmacopœia provides that cod liver oil shall be a pale yellowish oil obtained from fresh livers. Since excess acidity due to age can be easily removed, the only other indications of freshness are color, odor and taste. As it is almost impossible to set up any quantitative standards for odor and taste, color is left as the chief criterion of freshness. It should, however, be noted that other factors enter into the color of an oil: the fatness of the livers, the mode of rendering and the food of the fish. Oils from the Bay of Fundy may be reddish; Newfoundland, New England and Scottish oils may be dark yellow to amber; while Lofoten (Norwegian) oils are probably the lightest in color. Although the colors of these oils may not detract from their therapeutic efficacy, some of the darker oils in fact having a higher vitamin potency, the public has become accustomed to the light-colored oils for medicinal purposes; the darker oils are used primarily for stock and poultry feeding. The food and drug enforcement official is therefore confronted with the problem of setting up a dividing line between these two classes of oils. It is the purpose of this study to attempt to set up such a division on the basis of oils at present on the market.

Curve A represents two almost colorless oils of the 1932 season.

Curve B represents two very pale yellow Norwegian oils from two to six months old.

Curve C represents a large proportion of the oils examined, nineteen in number. They are pale yellow in color and have the following origin: ten are Newfoundland oils of the 1931 season; one is Norwegian, one year old; seven are miscellaneous importations of this year; and one is a two-year old specimen.

Curve D also represents a good proportion of the samples. There are eleven oils in this group. Though a little darker than the "C" group, they might still be classified as light yellow. Their origin is as follows: five are Norwegian, three of this season and two of 1930; three are Newfoundland; one is a New England-Newfoundland blend; one is an importation of this year and one is a four-year old specimen of unknown source.

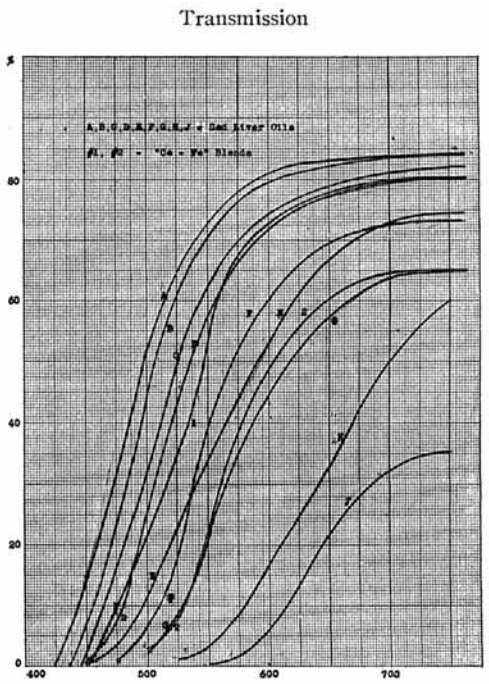


Fig. 1.—Cod liver oil.

Fifty-four samples of oil were examined, representing manufacturers' samples, importations received at the Bureau of Chemistry and samples obtained in the open market. It was found that when these oils were grouped on the basis of color they represented nine different hues. In Fig. 1 is shown the spectral transmission curves of these nine groups, from the lightest, "A," to the darkest, "J."

Since the oils included in the first four curves represent 64% of all the oils examined, and since their colors might reasonably be included under the term pale yellow or light yellow, it is believed that if any standard is to be set, it should not be lighter than that expressed by Curve D. Accordingly a "Co–Fe" blend was prepared to match the color of the group D oils.

Curve No. 1 represents the transmission of this "Co–Fe" blend, which was prepared by mixing 3.6 cc. of $M/4$ $CoCl_2 \cdot 6H_2O$, 48.4 cc. of $M/6$ $FeCl_3 \cdot 6H_2O$ and 68 cc. of distilled water. It will be noted that Curve No. 1 approximates Curve D fairly closely.

Curve E represents four oils which may be called distinctly yellow. One is a three-year old Norwegian oil, two are this year's importations, and one is a product which is being marketed as a poultry oil.

Curve F represents five yellow oils somewhat darker than the "E" group. Three are importations which were considered too dark by officials to be classified as of medicinal grade; one is a 1929 New England oil; and one is a 1927 blended oil.

Curve G is representative of one oil of light amber color. It is a blend of New England and Newfoundland catches, 1931 season. This oil meets all U. S. P. requirements except that of color. If it is desired to set a standard which will not exclude the more highly colored American oils, this would be the place to set such a standard. It must be realized of course that such a standard would permit oils now being marketed as stock feeds, as well as five-year old oils, to be accepted as within the requirements of the U. S. P. for medicinal cod liver oil. Curve No. 2 represents the "Co–Fe" blend which matches the color of the "G" oil. It is prepared by mixing 76 cc. of $M/6$ $FeCl_3 \cdot 6H_2O$, 11 cc. of $M/4$ $CoCl_2 \cdot 6H_2O$ and 33 cc. of distilled water. Curve H represents three amber-colored, imported oils having a rancid odor.

Curve J represents a reddish Norwegian oil about ten years old. Its odor is rancid.

In addition, three imported oils were so dark that their spectral transmission readings could not be taken. They are reddish black and have a nauseating, cheese-like odor.

None of the last seven oils would meet U. S. P. standards on the basis of odor alone; they are merely included for comparison.

The adoption of either standard No. 1 or standard No. 2 would require some statement such as the following as part of the monograph for cod liver oil: The oil, when placed in a 4-ounce, tall, cylindrical, standard oil-sample bottle, and viewed transversely, shall not be more highly colored than a solution placed in a similar bottle and containing 3.6 cc. $M/4$ $CoCl_2 \cdot 6H_2O$, 48.4 cc. $M/6$ $FeCl_3 \cdot 6H_2O$ and 68 cc. of distilled water. (Or if standard No. 2 is adopted, these figures would be 11 cc. $M/4$ $CoCl_2 \cdot 6H_2O$, 76 cc. $M/6$ $FeCl_3 \cdot 6H_2O$ and 33 cc. of distilled water.)

It would also be necessary to provide for two test solutions: $M/4$ $CoCl_2 \cdot 6H_2O$ contains 59.4965 Gm. of this salt per liter of 1% HCl. $M/6$ $FeCl_3 \cdot 6H_2O$ contains 45.054 Gm. of this salt per liter of 1% HCl. Provision should be made for standardizing these solutions volumetrically, as described in a previous paper.[1]

II. ALMOND OIL.

This oil did not offer quite so difficult a problem as the cod liver oil, as its range of color does not extend beyond a greenish yellow. Eleven oils were examined

[1] Arny and Taub, JOUR. A. PH. A., 12 (1923), 839.

representing manufacturers' samples and purchases on the open market. Although the U. S. P. describes almond oil as a clear, pale, straw-colored or colorless oil, less than half of the oils examined could be placed in this category.

Figure 2 shows the transmission curves of the five distinct hues into which these oils could be classified.

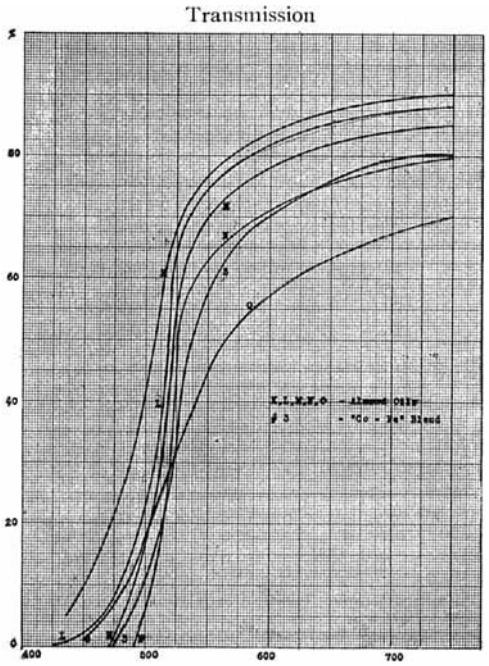
Curve K represents the lightest colored oil. It is an American oil which is almost colorless.

Curve L shows the transmission of an English oil which is a very pale yellow.

Curve M is representative of six French and Italian oils of a lemon-yellow shade; one of the oils was three years old, but the others were fresh specimens.

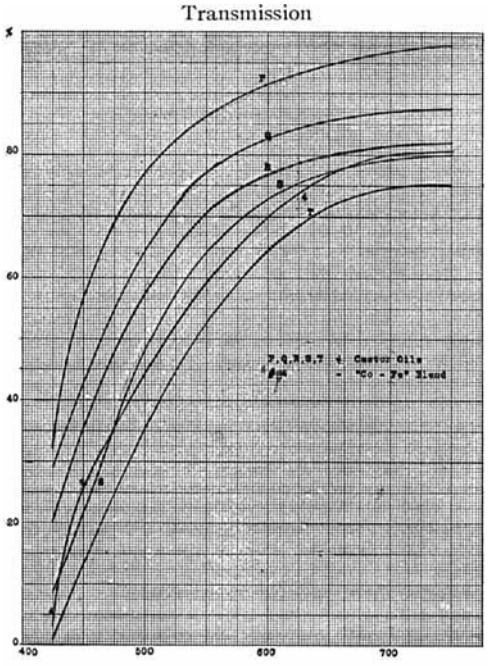
Curve N represents two oils of somewhat more intense hue than the "M" group. One was fresh, and one a year old.

Curve O is quite different in appearance than any of the others. The oil was a fairly old specimen which had developed a haziness and therefore would not conform to the U. S. P. on the question of clarity.



Wave-length in millimicrons

Fig. 2.—Almond oil.



Wave-length in millimicrons

Fig. 3.—Castor oil.

Curve P represents an oil which appears almost colorless.

Curve Q represents three oils which are a very faint yellow.

Curve R shows two oils which are pale yellow.

Curve S represents a pale yellow oil which has a very light brownish tint. This is the darkest color obtained for any of the fresh oils examined. It is obvious, of course, that these descriptions of color are purely qualitative and subjective. To a casual observer all of the above groups might appear nearly colorless.

Curve T represents two oils which are light yellow. Both are about five years old and have a rancid odor.

Curve No. 4 represents the transmission of the "Co–Fe" blend which has been set up as the standard. It matches group "S." The blend consists of 2.5 cc. of $M/4$ $CoCl_2 \cdot 6H_2O$, 8.5 cc. of $M/6$ $FeCl_3 \cdot 6H_2O$ and 111 cc. of 1% hydrochloric acid. The latter is used in place of distilled water since the amount of HCl present in the small volumes of the "Co" and "Fe" solutions would not be enough to prevent hydrolysis in so large a dilution.

It is believed that the "N" group represents the maximum intensity of color which good quality oils on the American market possess. A "Co–Fe" blend was accordingly prepared to match this color. Curve No. 3 shows the transmission of this blend, which consists of 68 cc. of $M/6$ $FeCl_3 \cdot 6H_2O$, 3.5 cc. of $M/4$ $CoCl_2 \cdot 6H_2O$ and 48.5 cc. of distilled water.

If this standard is adopted, the directions for matching should be similar to that specified under cod liver oil.

III. CASTOR OIL.

The U. S. P. X specifies that castor oil shall be a pale yellowish or almost colorless transparent liquid. The majority of the nine oils studied were practically colorless.

Figure 3 shows the curves of the five distinct hues into which these oils could be grouped.

As before, the directions for matching should be stated as under cod liver oil.

SUMMARY.

1. Fifty-four samples of cod liver oil were examined and color standards suggested for a lighter and a darker product.

2. Eleven samples of almond oil were examined and a standard proposed for maximum permissible color.

3. Nine samples of castor oil were examined and a standard proposed for maximum permissible color.

4. Directions have been given for preparing the permanent color standards, making use of the Arny "Co–Fe–Cu" color system.

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THE BACTERICIDAL EFFICIENCY AND TOXICITY OF CREOSOTE AND ITS COMPONENTS.*

BY LOUIS GERSHENFELD, RALPH PRESSMAN[1] AND HORATIO C. WOOD, JR.

The purpose for which this study was undertaken may be stated as follows: (1) to determine the variation in bactericidal power of creosote, (2) to determine whether the standards mentioned in the U. S. Pharmacopœia for specific gravity and boiling point are an indication of the therapeutic value of the drug, (3) to determine whether creosote depends largely for its therapeutic efficiency on the guaiacol and creosol as is implied in the official definition, (4) to determine if there are any one or two constituents to which the value of the drug may be justly attributed and (5) to determine whether different samples of creosote vary in their toxicity and if so can the variation be attributed to any special constituent.

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* Scientific Section, A. PH. A., Toronto meeting, 1932.

[1] Maltbie Chemical Co., Research Fellow, Philadelphia College of Pharmacy and Science, 1929–1931.