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A STUDY OF SOFT SOAP AND SOAPY PREPARATIONS MADE BY A COLD PROCESS.*

DAVID W. O'DAY[1] AND JAMES W. JONES.[2]

SOFT SOAP LINIMENT.

In 1935 Cox (1) suggested that cottonseed oil be used in place of linseed oil in the preparation of the official soft soap and soft soap liniment. The use of linseed oil soap in the preparation of the liniment was objected to because of the persistent linseed oil odor which remained after its use as a detergent. This odor remains even after the odor of lavender has been removed. Another objection to the U. S. P. X. formula for the liniment was that the preparation contained more alcohol than was necessary.

The following formula was proposed to overcome the objections mentioned above:

Cottonseed oil	305 cc.	Dekanormal Solution of Pot. Hydroxide	65 cc.
Oil of Lavender	20 cc.	Dekanormal Solution of Sod. Hydroxide	32 cc.
Alcohol	200 cc.	Water, a sufficient quantity to make	1000 cc.

Mix the cottonseed oil, oil of lavender, alcohol and the dekanormal solutions. When a clear solution results, add enough water to make the product measure 1000 cc.

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[1] Assistant Professor of Pharmacy, University of Colorado.

[2] Associate Professor of Pharmacy, State University of Iowa.

This formula has been used very successfully in the preparation of large quantities of liniment of soft soap for use at the hospitals connected with the State University of Iowa. It was thought that a study of the appearance and properties of liniment of soft soap prepared from various vegetable oils by the Cox Method might yield more extensive information concerning the possibilities of saponifying these oils by a cold process and might show the advantages of using certain oils other than linseed oil or cottonseed oil in its preparation.

To obtain this information the oils listed below were used in preparing the liniment according to the Cox Method given above. The amount of alkali used was varied slightly according to the composition of the oil being used in compounding the preparation. Since this liniment is used very extensively as a detergent, it was thought advisable to compare the lathering properties of the liniments prepared from the different oils. The appearance and lathering properties of these preparations are listed in Table I.

TABLE I.—LINIMENT OF SOFT SOAP.

Preparation from.	Color.	Lathering Properties and Cleansing Action.	Remarks.
Linseed oil	Amber	Fairly good. Yellowish foam, fairly abundant	Odor of linseed oil remains after using
Soya bean oil	Amber	Good. Abundant foam which is fairly lasting	Some odor of oil after using
Cottonseed oil	Medium light amber	Good. Abundant foaming	No definite odor of the oil. Cost reasonable
Sesame oil	Medium light amber	Good. Bubbles large	No advantages. Cost high
Almond oil	Light amber	Fairly good. Bubbles large	No advantages. Cost high
Corn oil	Medium light amber	Good. Quick forming and abundant lather	No definite odor of oil. Cost very reasonable
Peanut oil	Very light amber	Slow forming, heavy lather. Very lasting	Soap not formed very readily. Chief advantage is permanence of lather

It may be seen from Table I that the liniments prepared from sesame oil, almond oil and peanut oil offer no special advantages over those prepared from cottonseed oil and corn oil. The liniment prepared from soya bean oil has a good appearance, but some odor of the oil remains after a lather formed by the liniment has been rinsed away with water. However, this odor is neither as strong nor as objectionable as the odor of the preparation made from linseed oil. By using soya bean oil in place of linseed oil the cost of the preparation is decreased. Corn oil is very reasonable in price and appears to make a liniment equal to or superior to the preparation made with cottonseed oil.

SOFT SOAP.

A new formula for soft soap proposed by Cox specifies that cottonseed oil shall be used in place of linseed oil. The objection to linseed oil soaps is, as mentioned before, the persistent odor, while the objection to the use of cottonseed oil in making the soap has been the difficulty experienced in saponifying the oil. Cox has shown that this difficulty is eliminated if the proper method is used to make this soap. If too much water is present, the saponification process becomes more difficult. If very concentrated solutions of the alkalies are added to cottonseed oil, it is possible to bring about complete saponification without the use of heat.

The following formula proposed by Cox eliminates the use of alcohol or glycerin:

Cottonseed oil	430 Gm.
Dekanormal Solution of Pot. Hydroxide	100 cc.
Dekanormal Solution of Sod. Hydroxide	50 cc.
Water, a sufficient quantity to make	1000 Gm.

Mix the dekanormal solutions with the oil. Stir occasionally during three hours, then set aside for twenty-four hours. Add warm water enough to make the product weigh 1000 Gm.

This general formula was used in preparing soft soaps from the oils listed in Table II. The proper amount of concentrated alkali was added to the oil, and the mixture was stirred with a mechanical stirrer until a thick creamy emulsion was formed. Then, the emulsified mixture was set aside for twenty-four hours without heating.

(Continued from above. Same samples.)

Preparation Made from.	Lathering Properties.	Remarks.
Linseed oil	Heavy foam, not very voluminous	Odor persistent, sometimes objectionable
Soya bean oil	Rather quick-forming and copious lather. Fairly heavy	Odor fairly distinct, but not objectionable. Oil low priced
Cottonseed oil	Quick-forming lather. Rather thick and abundant	Oil fairly cheap
Sesame oil	Quick-forming lather. Rather large bubbles	Oil too expensive for this preparation
Almond oil	Quick-forming lather. Rather large bubbles	Oil too expensive for this preparation
Corn oil	Rather quick-forming and thick lather	Oil relatively cheap
Peanut oil	Slow-forming, heavy lather with small bubbles	Difficult to saponify

At the end of this period all the oils except peanut oil were completely saponified. Unlike the other oils employed, peanut oil did not form a homogeneous creamy emulsion when stirred and after twenty-four hours standing, some of the oil remained unsaponified. By rapid stirring it was possible to disperse the unsaponified oil in the semi-solid portion of the mixture; then the preparation was set aside for another twenty-four hours. At the end of this time the mixture was tested and showed complete saponification.

The method of saponification without the use of external heat seems most suitable for those oils which upon the addition of alkali form a thick homogeneous emulsion in which the oil is dispersed in fine globules by vigorous agitation. It is quite logical that the more surface of the oil exposed to the action of the alkali, the more readily the oil will be saponified.

The physical characteristics of the soaps made by this process are listed in Table II. From the information given in the table it can be seen that corn oil and soya bean oil, as well as cottonseed oil, may be used to make a very good quality of soft soap that is not exorbitant in price. Furthermore, no difficulty was experienced in saponifying these oils which formed soaps with a superior appearance without the use of heat. As noted in the table, some of the other oils make nice appearing soft soaps, but they are too expensive for use in this preparation.

TABLE II.—SOFT SOAP.

Preparation Made From.	Color.	Consistency.	Odor.
Linseed oil	Greenish amber	Soft	Definite odor of linseed oil
Soya bean oil	Light amber	Soft	Retains some odor of the oil
Cottonseed oil	Very light amber	Soft	Odor of oil not distinct
Sesame oil	Very light amber	Soft	Odor of oil not distinct
Almond oil	White or very light amber	Quite soft	Odor of oil not distinct
Corn oil	Yellowish light amber	Quite soft	Odor of oil not distinct
Peanut oil	Almost colorless. Tinge of amber	Stiff jelly-like mass	Odor of oil not distinct

CAMPHOR AND SOAP LINIMENT.

Jordan (2) and Cox (1) have suggested that camphor and soap liniment be prepared by a method in which the liniment is made from the required amount of olive oil and sodium hydroxide needed to make the amount of castile soap specified in the formula. Variations in the castile soap used cause variations in this liniment when it is prepared by the U. S. P. X formula.

The following formula prepared by Cox is compounded without difficulty and gives only a small amount of precipitate:

Olive oil	64 cc.	Camphor	45 Gm.
Oil of Rosemary	10 cc.	Dekanormal Solution of Sod. Hydroxide	18 cc.
Alcohol	700 cc.	Water, a sufficient quantity to make	1000 cc.

Dissolve the camphor and the oil of rosemary in the alcohol, add the olive oil, then the dekanormal solution of sodium hydroxide. Stir occasionally and when clear add the water. After twenty-four hours filter.

The small amount of glycerin which is formed upon saponification of the oil is not objectionable in the preparation.

Using the above formula, samples of the liniment were prepared using oleic acid and the various oils listed in Table III. The amount of alkali was altered slightly according to the product being saponified. The amount of precipitate formed after twenty-four hours standing was not large in any case. The observations made concerning these preparations are recorded in Table III.

TABLE III.—CAMPHOR AND SOAP LINIMENT.

Preparation Made from.	Amount of Precipitate Formed.	Color.	Remarks.
Olive oil	Small amount, flocculent	Almost colorless, greenish yellow tinge	Superior preparation
Cottonseed oil	Very small amount, fine	Almost colorless, yellowish tinge	Odor and appearance good
Almond oil	Very small amount	Almost colorless, very slight yellowish tinge	Odor and appearance good
Corn oil	Very small amount	Almost colorless, yellowish tinge	Odor and appearance very good
Soya bean oil	Small amount, flocculent	Almost colorless, yellowish tinge	Odor and appearance good
Peanut oil	Large amount of soap not in solution	Soap in solution almost colorless	Soap too hard for this preparation
Sesame oil	Small amount, fine	Colorless	Odor and appearance good
Oleic acid	Fairly small amount of precipitate, flocculent	Light amber	Appearance fair, some odor of oleic acid

Oleic acid was readily converted to sodium oleate, but a flocculent precipitate formed during the process of compounding the liniment. The odor of this liniment prepared from the acid was slightly harsh. The product obtained by the use of olive oil was superior in all respects. Corn oil formed a very desirable product, while the preparations formed by using cottonseed oil and soya bean oil were satisfactory. Peanut oil was completely unsatisfactory for the preparation of this liniment.

SAPONATED SOLUTION OF CRESOL.

Objections have been raised in regard to the dark color of Saponated Solution of Cresol made from linseed oil according to the official formula. Hilton (3) suggested a formula for the preparation of this solution in which oleic acid was used in place of linseed oil. The preparation made by this formula can easily be made in a period of 15 minutes and is much lighter in color than the official product. Jordan (2) in 1919 suggested an alteration in the directions for the preparation of the solution. According to Jordan's directions, the alkali was added to the linseed oil and the saponification process was completed before the cresol was added to the preparation. The product obtained by this method of preparation was lighter in color than the solution prepared by the official process.

Although the alkali used according to Jordan's directions was concentrated, it was thought that an alkali of a greater concentration might be used more advantageously in the preparation of saponated cresol solution without the use of heat. The alkali solution used in making this preparation according to the present official directions is quite concentrated. It was found that by altering the directions for preparation given in the U. S. P. XI saponated cresol solution could be prepared without the use of heat and the resulting product was much lighter in color. The amounts of the ingredients used were the same as those called for in the U. S. P. XI and the directions were altered as follows:

The concentrated alkali was added to linseed oil containing one per cent of cresol, and the mixture was stirred with a mechanical stirrer until a thick creamy emulsion was formed, then the mixture was set aside for twenty-four hours. At the end of this time the cresol (minus the amount used above as a catalyst) was added to the soap which was formed, and the mixture was agitated by means of a mechanical stirrer until a clear solution resulted. Finally, enough distilled water was added to make the solution the proper strength. The cresol and soap mix more readily if a little heat is applied, but any excessive use of heat results in a darkened solution.

In the above reaction the one per cent of cresol was added as a catalyst. Roschdestwensky (4) discovered that the reaction between alkali and oils is increased greatly by the addition of one per cent of aromatic hydrocarbons of phenolic character. Oils which require long periods of time for saponification are readily saponified in a much shorter time if the proper amount of cresol is added to aid the reaction. When large amounts of cresol are added, the reaction does not proceed any faster and the addition of very large amounts, such as the total amount used in the preparation of the cresol solution, seem to greatly retard rather than favor saponification. Other catalysts such as thymol, phenol, hydroquinone and betanaphthol can be used to advantage in preparing soft soap providing that the presence of these substances in the finished product is not considered objectionable.

In order that the character of the cresol solutions made by the use of other oils and by different methods might be determined, 100-cc. samples of this solution were made using oleic acid and the oils listed in Table IV. Two samples were made from each oil. The hot method (regular official method) was used in the preparation of one sample and the cold method (revised method) was used in the preparation of the other. The colors of the preparations made by each method and some other observations are given in Table IV.

TABLE IV.—SAPONATED SOLUTION OF CRESOL.

Preparation Made from.	Hot Method Color.	Cold Method Color.	Remarks.
Linseed oil	Dark reddish brown	Amber	Objections—dark color and persistent odor
Soya bean oil	Reddish brown	Amber	Makes a nice appearing preparation at a low cost
Cottonseed oil	Dark reddish brown	Amber	Quite turbid when added to tap water
Castor oil	Reddish brown	Amber	Quite turbid when added to tap water
Corn oil	Dark reddish brown	Amber	When prepared by cold method, it makes a nice appearing preparation.
Sesame oil	Dark reddish brown	Amber	Too expensive, no special advantages
Peanut oil	Dark reddish brown	Medium dark amber	Too expensive, harder to saponify
Oleic acid	Not used	Dark amber	No advantages except ease of preparation, cost prohibitive

Castor oil which was formerly used in preparing this solution according to the official British formula seems to offer no distinct advantages. All of the solutions made by both methods mixed well with distilled water and gave a clear solution. However when a hard water was used, the preparations made from cottonseed oil and castor oil seemed to give more turbidity than the preparations made from the other oils. The solution made by using oleic acid offered no advantages except ease and quickness of preparation. Oleic acid is more expensive than many of the vegetable oils. Sesame oil and peanut oil offer no advantages and are too expensive for use in such a solution. Soya bean oil forms a nice appearing solution when made by either the hot or cold method and may be purchased at a price below that for linseed oil. Corn oil makes an amber colored solution when the cold method is used, but the solution is much darker if the hot method is employed.

In another experiment a mixture of the alkalies was added to a mixture of linseed oil and cresol in a bottle, and the combined mixture was vigorously shaken for a short time. Then the preparation was set aside and shaken occasionally. At the end of ten days without the use of heat the sample gave a clear solution when added to nine times its volume of distilled water. Sufficient distilled water was then added to dilute the preparation to the proper strength. This method of preparation might be advantageous where ease of preparation is desired and where the preparation is not needed in a hurry.

If the linseed oil and alkalies are mixed until a creamy emulsion is formed and then the cresol is added without waiting for complete saponification to take place, the mixture formed will give a clear solution with distilled water after standing for a period of four days. It is interesting to note that the solutions prepared by the last two methods have a darker color than those prepared by the regular revised formula.

If cresol is mixed with an equal weight of any of the soft soaps prepared by the Cox Method and solution is effected, the resulting preparation will give a clear solution when mixed with distilled water. Saponated Solution of Cresol could be made by this method when a sufficient quantity of soft soap is available.

CONCLUSIONS.

1. The official soap preparations made by the cold saponification process all possess a better appearance than those prepared by the official processes.
2. Soya bean oil or corn oil form excellent products, devoid of objectionable odor and low in price.
3. The use of heat in the saponification process tends to produce darkened products.
4. Saponated Solution of Cresol may be prepared without the application of heat and the preparations made by the cold process are much lighter in color.

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THE RECOVERY OF SILVER FROM EXHAUSTED FIXING BATHS BY PRECIPITATION WITH SULFURATED POTASH.*

A PROFITABLE PROCEDURE FOR THE HOSPITAL PHARMACIST.

BY EDWARD C. WATTS.[1]

Although the recovery of silver from exhausted fixing bath solutions has been known to be practical and worthwhile for a great number of years, this procedure still seems to be overlooked or given an insufficient amount of attention by hospitals throughout the country. This should not be so, for this process is the means of effecting a considerable reduction in the operating budget. With all the agitation for more and better hospitalization at a lower cost it behooves every one connected with this vast enterprise to know how and where costs may be reduced. Hospital pharmacists because of their knowledge of Chemistry will appreciate that this reclamation is, after all, comparatively simple and inexpensive.

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[1] Assistant Chief Pharmacist, University Hospital, Ann Arbor, Mich.