it was still prime, so that the full benefit of the saving in loss would be realized.

In the table, all the tests showing an improvement in loss plus color are averaged in one group, and all those showing no improvement in another. In the improved group the average refining results are somewhat higher than those of the other groups, indicating that mixing Expeller oil with hydraulic press oil is more likely to effect improvement in the case of the poorer quality oils. While this may be true on the average, there are notable exceptions, such as, oil No. 2, which showed decided improvement even though exceptionally good quality originally.

The data does not show any relation between the amount of improvement effected and with either the gossypol content of the original hydraulic press oil or the total gossypol content of the mixture. This is probably due to the influence on refining results of factors other than gossypol content; also possibly the oil mixtures contained gossypol in excess of the amounts necessary to produce maximum effect on final refining loss.

Summary

1. The refining loss of some hydraulic press cottonseed oils were reduced by mixing them with 30% of Expeller oils before refining.
2. This improvement apparently was due to the high gossypol content of the Expeller oils.
3. The amount of improvement was greatest for hydraulic press oils which gave soft, oily soapstocks when refined alone.
4. The amount of improvement was not primarily dependent on the quality of the hydraulic press oil treated, since one very good quality oil gave a decided improvement under the conditions of these tests.

Literature Cited

(1) Royce and Lindsey—Ind. & Eng. Chem., 25, 1047 (1933).

Press Room Operation As It Affects The Quality of Cottonseed Oil*

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IN discussing this subject, the speaker well recognizes the fact that much has been said and written previously. However, some of the points raised in this paper are of sufficient importance to justify repetition.

In this paper the factors influencing the quality of the oil will be limited to the cooking of meats and settling of the oil since an extended discussion of all factors involved would require more time than has been allotted.

Perhaps the first thing to discuss would be the rate of heating as it influences the refining loss. For years it was the general practice for the rolled meats to be slowly raised to the correct cooking temperature, then held at that temperature for sufficient time to obtain maxmium yields. Numerous experiments have shown that the more rapidly the meats are raised to 190 degrees Fahrenheit, or above, the lower the refining loss and the better the color. The following table shows this very definitely:

TABLE I.—EFFECT OF RATE OF HEATING ON REFINING LOSS

No.	Time for temp. to reach 190°	Final temp.	Total time in cooker	F. F. A. per cent	Refining loss per cent	Color Red
1.....	30 min.	235° F.	40 min.	1.75	9.00	5.8
2.....	15 min.	235° F.	40 min.	1.8	7.4	5.3
3.....	29 min.	225° F.	40 min.	1.5	8.75	5.5
4.....	15 min.	225° F.	40 min.	1.4	7.00	5.0
5.....	30 min.	220° F.	40 min.	1.6	9.00	5.0
6.....	14 min.	220° F.	40 min.	1.65	6.8	4.7

The above figures are the average of several runs under similar conditions from the same seed and show that rapid heating of the seed in the early stages of cooking is beneficial.

The method of adding moisture to the meats has been studied and the results given in the following tables:

TABLE II.—EFFECT OF TIME AND TEMPERATURE AT WHICH WATER WAS ADDED TO THE FOLLOWING MEATS.

No.	Time water added	Temp. of water	Temp. of meats when added	Final Temp.	F.F.A.	Refining Loss	Color
1.....	Beginning	90° F.	Cold	225° F.	4.0	10.0	8.0
2.....	After 15 min.	190° F.	195° F.	225° F.	3.3	8.6	6.5
3.....	Beginning	90° F.	Cold	225° F.	1.4	9.0	7.1
4.....	After 15 min.	190° F.	190° F.	225° F.	1.5	5.6	5.0

In the above table, experiments Nos. 1 and 2 were made with seed from one source while experiments 3 and 4 were made with seed from a different source. All conditions except those indicated were constant.

This indicates that if the water is added after the meats are hot, there is a decided lowering in the refining loss. It might be stated that the oil content of the cake in those experiments where water was added to the hot meats was lower than when added at the beginning. In other experiments along this line it was shown that there were no water balls formed when hot water was added to hot meats, even though enough water was added to slush around in the kettle. Under similar tests cold water on cold meats gave large numbers of water balls.

The effect of length of time of cooking at the different temperatures was next studied. In this case, the protein in the meats was uniform, though the protein in the cake varied about 1.5 per cent. The time required to bring the meats to the cooking temperature was 25 minutes. The moisture added to the meats was increased as the cooking temperature increased to compensate for the additional evaporation. It is recognized that this will influence the results to some

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extent, but could not be helped if a reasonably uniform cake was to be drawn. The oil left in the cake was virtually constant, varying only 0.5 per cent from the lowest to highest, which indicates that the amount of cooking received at the lowest temperature and for the shortest time was sufficient.

The results obtained are shown in the following table:

TABLE III.—EFFECT OF TIME AND TEMPERATURE OF COOKING COTTONSEED MEATS UPON REFINING LOSS OF THE OIL.

No.	Temp.	Time	F.F.A.	Refining Loss	Color
1.....	215° F.	40 min.	.75	6.7	4.9
2.....	215° F.	60 min.	.8	7.3	4.8
3.....	215° F.	80 min.	.75	8.3	4.8
4.....	220° F.	40 min.	.65	7.6	5.1
5.....	220° F.	60 min.	.75	7.8	4.8
6.....	220° F.	80 min.	.65	9.1	4.9
7.....	225° F.	40 min.	.7	7.4	5.0
8.....	225° F.	60 min.	.9	7.4	4.7
9.....	225° F.	80 min.	.6	7.2	4.8
10.....	230° F.	40 min.	.75	7.5	4.8
11.....	230° F.	60 min.	.75	7.9	4.9
12.....	230° F.	80 min.	.60	9.3	4.8
13.....	235° F.	40 min.	.80	8.2	5.1
14.....	235° F.	60 min.	.70	8.8	5.0
15.....	235° F.	80 min.	.50	9.7	4.8

A study of the foregoing table reveals that as the length of time of cooking is increased the refining loss increases. In all cases the color was virtually constant. This phase of the work was repeated with different seed and the results are given in the following table:

TABLE IV.

No.	Temp.	Time	F.F.A.	Refining Loss	Color
1.....	225° F.	40 min.	.70	7.5	4.7
2.....	225° F.	60 min.	.90	7.9	4.9
3.....	225° F.	80 min.	.70	10.8	4.8

This further substantiates the conclusion that excessive cooking results in an increased refining loss.

It has been stated that excessive cooking would "set" the color in the oil. While the writer believes that this is true and has observed such to be the case in other experiments, such was not observed in these experiments, though no bleaching tests were made on these oils.

A further study of Table IV shows that increasing the temperature increases the refining loss and in these experiments did not produce any increase in oil yield. The data to substantiate this statement are not included in these tables, but are contained in unpublished data (A. and M. Theses).

Other experiments indicate that the color is fixed by high temperatures, but the data shown here do not show such.

In addition to cooking playing a major part in the quality of the oil, settling of the oil plays a great part. To study this factor, several liter cylinders were placed in constant temperature baths at different temperatures and filled with oil from the presses. The depth of clear oil was determined in each case. The oils held at temperatures of 90° to 110° F. settled out better than those held at other temperatures.

It was observed that high temperatures did not settle out. Since the high temperatures were high enough to drive off the small amount of moisture that was present, another sample of oil was taken and placed under a vacuum of 170° F. for 30 minutes, then cooled to 110°. This dried oil did not settle, but the foots remained in a fine suspension for a week when the experiment was discontinued.

A second sample was taken from the press and one cc. of water added to one liter of oil and stored at 110° F. The foots from this settled in large flocs and in 24 hours the foots had completely settled and occupied a volume of about 100 cc. in the bottom of the cylinder, but the oil above was perfectly clear (Jeffrey A. and M. Thesis).

From the foregoing discussion it is obvious that oil that is brought from the presses at such a high temperature that it is dry or nearly so will not settle properly and excessive foots will be shipped to the refiner where excessive losses will be the penalty. It is not suggested that water be added to the oil, though if it could be added uniformly in amounts corresponding to .05 per cent to 0.1 per cent the results would be beneficial.

After studying the above tables and others similar to them, the question arose as to what took place during cooking. To make this study, the soap stock was carefully analyzed and the results calculated back to the original oil basis.

The oil used in these experiments was carefully strained through muslin as it came from the presses to make sure that no meal was entrained. The oil was cooled but was not settled before refining.

The fat, nitrogen, soap, excess lye, and moisture were determined on the soap stock and the difference between the sum of these and 100 was called nitrogen free extract.

It was found that as the time of cooking was increased, and the temperatures increased, there was an increase in the amount of N. F. E. and as the rate of heating during the early stages of cooking was increased the amount of N. F. E. decreased. It was further found that as the N. F. E. in the oil increased the refining loss increased (North and Siecke A. and M. College Theses).

A further study of the effect of cooking on the protein was made and it was found that increasing the time and temperature of cooking, more nitrogen appeared in the oil (Adams A. and M. Thesis, 1936).

In conclusion it may be stated that cooking for as short a time as practical and at as low a temperature as practical with the temperature being brought to 190° to 200° F. in 15 to 20 minutes, and the water being added hot after the temperature has reached 190° and then settling the oil at 110° F. will result in oils having the lowest refining losses and with the best color.

Application

Application for Referee Certificate. Mr. Vincent S. Skinner of Shilstone Testing Laboratory, Houston, Texas, has applied for a Referee Certificate reading on the analysis of all cottonseed products.