

Report of Committee on Crude Mill Operations

BY ANDREW K. SCHWARTZ, CHAIRMAN

A PRELIMINARY survey of cooking methods to determine if the cooking process had any material effect upon the quality of crude produced was the object of this year's investigation by this committee.

The first work was undertaken with French continuous or stack cookers. It is not reported here because it was found that seed storage conditions were such that the variation of seed made comparative tests impossible. Then too this type of cooker requires a long time for adjustment, which accentuated the difficulty of obtaining a uniform seed.

The experiments reported here were made in the Houston Cotton Oil Mill, an eight-press Mill using four Smith Vaile Open Cookers.

Origin of Seed: All Cotton Seed used had their origin in South Texas, and are what is commonly called Valley seed. They were upon arrival at the Mill dry prime seed and were stored for about four months before being milled.

Description of Cooking Unit: The cooking unit consisted of a jacketed conveyor, chutes or bins above the cookers and cookers proper. The ground seed dropped from the rolls into a conveyor, which fed an elevator. This conveyor was equipped with both a water and steam nozzle so that moisture could be added in either form. From the elevator the seed passed through the jacketed conveyor into a distributing conveyor feeding the cooker bins where the meats remained from one-half to

one hour being charged into the cooker.

The jacketed conveyor was 22 feet long, 17 inches wide, having a heating surface of 49 square feet. At 50 pounds steam pressure the heat applied by this conveyor raised the seed temperature about 15 degrees Fahrenheit.

The cookers proper were 64 inches inside diameter, 26 inches deep, having a heating surface of 58.6 square feet. The meat charge when loaded to 4 inch outage was enough to fill four presses or approximately 1300 pounds. Each cooker was equipped with a half inch steam line for application of direct steam.

Pressing: In all experiments reported the conditions of pressing were constant. The meats were loaded into the presses in cakes weighing approximately 22 pounds. Each press was loaded with 15 cakes. Low pressure was applied for about one minute before the high pressure took effect. Maximum pressure of 4,000 pounds was reached in 7 minutes. The total time under pressure was 18 minutes. The schedule of the presses was 24 minutes.

Sampling: The following samples were taken:

1. Delinted seed before hullers.
2. Rolled meats after moisture addition, if any.
3. Cooked meats leaving cooker.
4. Cake.
5. Oil.

1. Delinted seed sample was taken continuously by hand from a conveyor during a period so

timed that the same seed was sampled that afterward arrived in a definite cooker. These seed were previously delinted of 108 pounds of lint per ton of seed worked.

2. and 3. Rolled and cooked meats were sampled in the same manner as delinted seed. Samples were preserved in friction top cans until quartered and analyzed twenty-four hours later.

4. Cake samples were taken as follows: All the cake from one press representative of the test was quartered, a different quarter being taken from succeeding cakes. These cakes were broken and ground to a pea sized meal. The mixture was quartered to about ten pounds. This meal was finely ground and quartered to analysis size.

5. Oil sample was taken by catching all the oil flowing from the press from which the cake sample was taken. This was mixed and reduced to two gallon size. A portion of this oil was filtered through a coarse filter paper to remove any coarse particles of meal present. The oil was then analyzed.

Ten samples of oil, when filtered in this manner, were compared for refining loss with the unfiltered oil with the following average results:

	Filtered	Unfiltered	Maximum Variation
Per cent loss.	6.08	6.01	0.5
Color	35 Y 4.80 R	35 Y 4.99 R	1.0 R

It was found that the results of the unfiltered oil bore the same relation to one another that did the filtered oil.

Other Conditions: Temperature of cooked meats as given in the experimental data was taken by immersion of a thermometer in 15 pounds of meats after discharged from cooker. This temperature did not agree with that shown by a

thermometer placed in a well which in turn was partially immersed in the meats within the cooker.

As a comparison indicating the difference; the temperature caught as is recorded in the tables was 205° F. That shown by a thermometer placed in the cooker was at different intervals as follows:

2 min. after loading	175	degrees
5 " " "	180	"
8 " " "	193	"
12 " " "	208	"
17 " " "	215	"
22 " " "	217	"
28 " " "	218	"
35 " " "	218	"

The temperature of the direct steam entering the cooker was considerably higher than any of the temperatures given above.

The figure given as the quantity of direct steam entering the cooker was calculated assuming atmospheric pressure to exist in the cooker.

Color of meal is reported comparatively assigning the lowest number to the highest colored meal.

Analysis: All analyses were made according to the official method except the refining test where one sample of each set of tests was refined with these different lyes and the whole set re-

fined with the lye giving best results.

For neutral oil test the Wesson method was employed.

Object of and Conclusion of Experiment No. 1

The object of Experiment No. 1 was to determine if the use of a slight preheating of seed without

previous addition of water had any effect upon the crude oil.

It was found that in all of these comparative tests the preheated meats gave a better oil extraction

as indicated by a lower standard. This decrease in standard averaged four points. Change in quality of crude oil produced occurred. The loss on refining showed no con-

EXPERIMENT NO. 1

CONDITIONS

	1A	1B	2A	2B	3A	3B	4A	4B
Time of Cook Min.	40	40	40	40	40	40	40	40
Temp. of Cook ° F.	202	204	206	205	205	205	212	210
Jacket Pressure Lbs.	30	30	30	30	None		30	30
Rate of Direct Steam Addition								
Lbs. per min.	27	27	83	83	83	83	83	83
Pressure of Direct Steam. ...	110	110	110	110	110	110	110	110
Form of Moisture Addition								
before preheater			None		None			
Temp. of Preheated Seed. ...	120	107	120	107	128	115	128	118
Pressure on Preheater.	50		50		65		65	

SEED ANALYSIS

	1A	1B	2A	2B	3A	3B	4A	4B
% H ₂ O	9.0	9.8	9.1	9.1	8.5	8.5	8.7	8.4
% Oil	20.35	21.18	20.80	20.35	19.55	19.76	18.98	20.01
% NH ₃	4.17	4.20	4.30	4.13	4.48	4.41	4.47	4.59
% FFA in Oil in Sd.	1.25	1.55	1.15	2.10	1.85	1.15	1.55	1.10
% Damage	1	4	1	2	4	2	0	0
% Immature	1	1	2	3	0	0	6	2

MEATS ANALYSIS

	1A	1B	2A	2B	3A	3B	4A	4B
% NH ₃ Before Cook	5.73	5.70	5.73	5.63	6.60	6.38	6.63	6.27
% H ₂ O Before Cook	8.1	7.9	8.2	7.9	7.0	7.1	7.2	7.2
% H ₂ O After Cook	8.0	8.8	8.3	8.9	9.8	10.0	7.3	7.4

CAKE ANALYSIS

	1A	1B	2A	2B	3A	3B	4A	4B
% H ₂ O	7.9	8.6	8.0	7.7	10.7	10.4	7.7	9.0
% Oil	5.60	6.00	5.65	6.02	7.32	7.16	8.04	8.25
% NH ₃	7.67	7.61	7.57	7.60	8.67	8.28	8.51	8.23
Standard	73.0	78.8	74.7	79.2	84.4	86.4	94.5	99.7
Color No.	2	1	2	1	1	2	1	2

REFINING TEST

	1A	1B	2A	2B	3A	3B	4A	4B
% NaOH Solution	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Degree Baume	14	14	14	14	14	14	14	14
% Loss	5.4	5.1	5.1	5.2	5.5	5.4	6.6	6.2
Color—Yellow	35	35	35	35	35	35	35	35
Color—Red	6.0	5.8	6.0	5.5	6.2	5.5	5.3	5.0
3% Official								
Earth Bleach—Yel.	20	20	20	20	20	20	20	20
3% Official								
Earth Bleach—Red	2.6	2.5	2.5	2.3	2.9	2.7	2.5	2.5

OIL ANALYSIS

	1A	1B	2A	2B	3A	3B	4A	4B
% F.F.A.	1.29	1.31	1.32	1.39	1.51	1.37	1.55	1.40
Color 1 in. cell—Yel.	50	50	50	50	50	50	50	50
Color 1 in. cell—Red	30.0	27.0	26.0	29.0	55.0	47.0	57.0	50.0
% H ₂ O .....	.06	.08	.10	.07	.08	.08	.12	.10
% Gums .....	.59	.41	.52	.55	.70	.65	.90	.91
% Neutral Oil	98.06	98.20	98.06	97.99	97.71	97.90	97.43	97.59

sistent tendency either to increase or decrease. Although there was an average increase in loss of 0.2% for the four comparisons, the color of refined and bleached oil was worse in every case where pre-heating was employed averaging

0.4r increase in refined and about 0.1r in bleached color.

Remarks: All soaps produced in refining were firm. The meats of test 3a, when subjected to pressure in press, showed a slight squeezing action.

EXPERIMENT NO. 2

CONDITIONS

	1A	1B	1C	2A	2B	2C	3A	3B	4A	4B
Time of Cook Min.	40	40	40	40	40	40	40	40	40	40
Temp. of Cook ° F.	195	207	213	223	231	221	202	206	212	213
Jacket Pressure Lbs.	30	30	30	70	70	70	30	30	70	70
Rate of Direct Steam Addition Lbs. per min.	0	10	20	19	38	57	27	83	27	83
Pressure of Direct Steam ..	0	30	30	70	70	70	110	110	110	110
Form of Moisture Addition Before Preheater.	Dry		Dry		Dry		Dry			
Temp. of Preheated Seed. ..					None					
Pressure on Preheater.					None					

SEED ANALYSIS

% H ₂ O	8.8	8.2	9.5	8.5	8.6	8.5	9.0	9.1	9.3	9.7
% Oil	20.16	19.95	19.60	19.75	19.79	21.34	20.35	20.80	21.20	20.80
% NH ₃	4.22	4.27	4.31	4.31	4.40	4.36	4.17	4.30	4.09	4.16
% FFA in Oil in Seed	1.45	0.95	0.95	0.80	1.05	0.95	1.25	1.15	1.30	1.40
% damage	5	0	5	0	0	0	1	2	3	1
% Immature	1	2	2	1	2	5	1	2	2	1

MEATS ANALYSIS

	1A	1B	1C	2A	2B	2C	3A	3B	4A	4B
% NH ₃ Before Cook ..	6.25	6.21	6.31	6.03	6.08	6.08	5.73	5.73	5.60	5.78
% H ₂ O Before Cook ..	8.1	8.1	8.3	7.8	7.5	7.8	8.1	8.2	7.9	7.6
% H ₂ O After Cook ...	6.5	7.2	7.8	6.2	5.1	6.4	8.0	8.3	7.3	7.7

CAKE ANALYSIS

% H ₂ O	7.2	6.9	7.4	6.8	6.3	6.6	7.9	8.0	7.3	7.3
% Oil	8.49	7.67	6.83	6.26	5.97	6.11	5.60	5.65	5.86	6.00
% NH ₃	8.45	8.43	8.48	8.10	8.18	8.13	7.67	7.57	7.53	7.75
Standard	101.5	91.0	80.6	77.3	73.0	75.2	73.0	74.7	77.8	77.5
Color No.	1	2	3	1	2	3	2	1	2	1

REFINING TEST

% NaOH Solution ..	7.6	7.6	7.6	8.8	8.8	8.8	7.0	7.0	7.0	7.0
Degree Baume	16	16	16	14	14	14	14	14	14	14
% Loss	6.8	6.0	5.7	6.2	6.0	5.5	5.4	5.1	5.8	5.4
Color—Yellow	35	35	35	35	35	35	35	35	35	35
Color—Red	4.2	5.0	4.4	4.5	4.5	4.4	6.0	6.0	5.5	5.0
3% Official Earth Bleach—Yellow	20	20	20	20	20	20	20	20	20	20
3% Official Earth Bleach—Red	1.8	2.0	1.8	2.0	2.0	2.0	2.6	2.5	2.2	2.2

OIL ANALYSIS

	1A	1B	1C	2A	2B	2C	3A	3B	4A	4B
% F.F.A.	1.55	1.45	1.32	1.25	1.20	1.25	1.29	1.32	1.57	1.40
Color 1 in. Cell—Yel...	50	50	50	50	50	50	50	50	50	50
Color 1 in. Cell—Red..	47.0	34.0	27.0	41.0	42.0	42.0	30.0	26.0	50.0	43.0
% H ₂ O .....	.06	.07	.07	.09	.08	.06	.06	.10	.10	.06
% Gums .....	.60	.42	.39	.57	.56	.56	.59	.52	.58	.40
% Neutral Oil	97.79	98.06	98.22	98.09	98.16	98.13	98.06	98.06	97.75	98.14

Object of and Conclusion of Experiment No. 2

The tests of Experiment No. 2 were made to determine the effect of the continuous addition of direct steam, during the cooking process, or unmoistened meats.

It was found that such addition effected the standard of extraction, but little, except where low jacket pressure and small quantities of dried steam were employed in which case the improved extraction may be accounted for by insufficient application of heat. This probability is further indicated by the high standards under these conditions.

The quality of crude was mate-

rially changed by direct steam application. The losses were consistently lowered in these tests averaging a 0.6% improvement between maximum and minimum application. The color of refined and bleached oils remained materially the same. The color of crude oil appeared lighter where steam was applied.

Object of and Conclusion of Experiment No. 3

By the production of 41.8% and 48.7% protein meals it was sought to determine if increased addition of hulls detrimentally affected the oil. If anything the reverse appears to be the case.

EXPERIMENT NO. 3

CONDITIONS

	1A	1B
Time of Cook Min.	40	40
Temp. of Cook ° F.	221	221
Jacket Pressure Lbs.	70	70
Rate of Direct Steam Addition Lbs. per min. . .	57	57
Pressure of Direct Steam	70	70
Form of Moisture Addition before Preheater.	Dry	Dry

SEED ANALYSIS

	8.5	8.5
% H ₂ O	8.5	8.5
% Oil	21.34	19.65
% NH ₃	4.36	4.33
% FFA in Oil in Sd.	0.95	1.20
% Damage	0.	0.
% Immature	5	1

MEATS ANALYSIS

	6.08	7.03
% NH ₃ Before Cook	6.08	7.03
% H ₂ O Before Cook.	7.8	7.6
% H ₂ O After Cook	6.4	5.4

CAKE ANALYSIS

	6.6	6.8
% H ₂ O	6.6	6.8
% Oil	6.11	7.38
% NH ₃	8.13	9.47
Standard	75.2	77.9
Color No.	2	1

REFINING TEST

	1A	1B
% NaOH Solution	8.8	8.8
Degree Baume	14	14
% Loss	5.5	6.4
Color	35Y 4.4R	35Y 4.8R
3% Official Earth bleach.	20Y 2.0R	20Y 2.0R

OIL ANALYSIS

	1.25	1.38
% F.F.A.	1.25	1.38
Color one inch cell.	20Y 42.0R	50Y 55.0R
% H ₂ O .....	.06	.10
% Gums .....	.56	.54
% Neutral Oil	98.13	97.98

Object of and Conclusion of Experiment No. 4

With addition of moisture in the form of steam before cooking and without only moisture addition it was sought to determine the effect of increased cooking time.

It was found that if sufficient moisture was present increased cooking time improved the extraction as represented by the standard of meal; to decrease the loss on refining; to darken the color of refined and bleached oil and to lighten the color of crude oil.

EXPERIMENT NO. 4

CONDITIONS

	1A	1B	1C	2A	2B	2C	3A	3B	4A	4B
Time of Cook Min.	25	45	75	25	45	75	35	70	35	65
Temp. of Cook ° F.	194	208	210	205	217	230	213	238	205	205
Jacket Pressure Lbs.	30	30	30	75	75	75	70	70	None	
Rate of Direct Steam-Addition Lbs. per min.	30	30	30	67	67	67	83	83	83	83
Pressure of Direct Steam.	30	30	30	75	75	75	110	110	110	110
Form of Moisture Addition before Preheater	Steam		Steam		Steam		Dry	Dry	Dry	Dry
Temp. of Preheater (Seed)	150	150	150	150	150	50	—	—	—	—

SEED ANALYSIS

% H ₂ O	9.2	9.3	9.0	8.8	8.9	9.0	8.7	9.0	8.5	8.7
% Oil	20.28	19.85	19.81	20.90	20.08	20.30	20.80	21.01	19.76	19.82
% NH ₃	4.38	4.39	4.41	4.41	4.44	4.46	4.16	4.26	4.46	4.43
% FFA in Oil in Seed	1.40	1.25	1.20	1.50	1.05	1.20	1.40	1.05	1.15	1.45
% Damage	1	0	1	1	0	0	1	1	1	0
% Immature	2	2	3	1	4	4	1	2	1	4

MEATS ANALYSIS

% NH ₃ Before Cook	6.23	6.23	6.26	6.28	6.23	6.38	5.78	5.68	6.33	6.27
% H ₂ O Before Cook	10.7	9.8	10.1	9.2	9.1	9.7	7.6	7.8	7.1	7.5
% H ₂ O After Cook	9.5	7.6	6.6	8.4	6.3	6.9	7.7	4.4	10.0	9.7

CAKE ANALYSIS

	1A	1B	1C	2A	2B	2C	3A	3B	4A	4B
% H ₂ O	10.4	9.1	8.6	9.3	7.7	6.2	7.3	5.2	10.4	10.4
% Oil	6.86	5.83	5.81	6.80	6.04	5.66	6.00	6.74	7.16	7.39
% NH ₃	8.70	8.83	8.83	8.80	8.83	8.85	7.75	7.74	8.28	8.16
Standard	78.9	66.0	65.8	77.3	68.4	64.0	77.5	87.1	86.4	90.6
Color No.	1	3	2	1	2	5	2	1	2	1

REFINING TEST

% NaOH solution	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Degree Baume	14	14	14	14	14	14	14	14	14	14
% Loss	9.0	8.5	8.8	9.7	9.1	8.8	5.4	5.8	5.4	5.8
Color—Yellow	35	35	35	35	35	35	35	35	35	35
Color—Red	5.5	5.8	5.7	5.4	5.5	6.0	5.0	5.8	5.5	6.3
3% Official earth bleach—Yellow	20	20	20	20	20	20	20	20	20	20
3% Official earth bleach—Red	2.5	2.7	2.5	2.4	2.5	2.6	2.2	2.5	2.7	3.0

OIL ANALYSIS

% F. F. A.	1.60	1.45	1.50	1.50	1.42	1.42	1.40	1.38	1.37	1.56
Color 1 in. cell—Yellow	50	50	50	50	50	50	50	50	50	50
Color 1 in. cell—Red	42.0	26.0	...	46.5	27.0	22.0	43.0	32.0	47.0	68.0
% H ₂ O . . . . .	.07	.08	...	.09	.13	.07	.06	.08	.08	.09
% Gums . . . . .	.44	.33	...	.52	.52	.49	.40	.66	.65	.71
% Neutral oil	97.89	98.14	...	97.89	97.93	98.02	98.14	97.88	97.90	97.64

Where no moisture is added the length of cooking time is limited and an increase of time decreases the extraction, increases the loss on refining and reddens both refined and bleached oils, but lightens the color of crude.

Test No. 4 was made using direct steam only for application of heat. The effect on oil and extraction was the same as where unmoistured seed were employed except that the color of crude was darkened by increased time.

Remarks: The loss on refining when steam is added before cooking is abnormally high due to the effect of exposure of ground meats to moisture and high temperature for about three quarters of an hour. All soaps from these refinings were unfirm. (See Experiment Nos. 5 and 6). In the refining of Nos. 1A, 1B and 1C, and 2A, 2B and 2C, it was apparent that the longer cooking gave an oil which broke quicker on refining and soap particles finer in size and lighter in color. The soaps from refinings 3A, 3B, 4A and 4B were all firm. No. 1A squeezed from press. No. 3B was too dry (over cooked) cake fell from press cloth. Nos. 4A and 4B showed slight squeezing action in press.

Object of and Conclusion of Experiment No. 5

The object of Experiment No. 5 was to determine if the form of moisture, whether employed as steam or as water, introduced before cooking, effected the refining loss. These tests were carried on with and without the addition of direct steam into cookers.

In each case the introduction of direct steam into the cooker improved the meal standard of ex-

traction. The introduction of water before the cookers increased the loss on refining about 0.6%, darkened the refined color about 0.3r, while steam increased the loss 2.8% and darkened the refined color 0.8r. The bleach on oil remained the same in all cases.

The addition of steam before the cookers preheated the meats to about 150°. The addition of water without any preheat shows no increase in refining loss. (See Experiment No. 7). In this Experiment the increase of loss on water addition was due to the cuse of the preheater. (See Experiment No. 1).

The addition of steam shows increasing loss as the wetted meats are allowed to stand for a longer time. (See Experiment No. 6).

The increase in loss shown by steam wetted meats is due to the combined action of water, increased temperature and time of standing before the cook.

Steam offers no advantage over water with regard to standard of extraction.

Remarks: Soaps from refinings 3A and 3B were soft. All other soaps were firm, gave up no oil on remelting and the refined oil could be easily poured from them.

EXPERIMENT NO. 5

CONDITIONS	1A	1B	2A	2B	3A	3B
Time of cook min.	40	40	40	40	40	40
Temp. of cook °F.	209	210	204	210	210	209
J a c k e t pressure lbs.	45	45	45	45	45	45
Rate of direct steam addition lbs. per min....	..	45	..	45	..	45
Pressure of direct steam .....	..	45	..	45	..	45
Form of moisture addition before preheater	Dry	Dry	Water	Water	Steam	Steam
Temp. of preheat- ed seed	115	115	115	115	160	160
Pressure on pre- heater	45	45	45	45	45	45

(Table 5—Continued)

SEED ANALYSIS

% H ₂ O	9.1	..	8.8	..	8.1	..
% Oil	20.90	..	20.27	..	20.38	..
% NH ₃	4.48	..	4.44	..	4.44	..
% FFA in oil in seed	0.95	..	1.30	..	0.85	..
% Damage	1	..	0	..	0	..
% Immature	1	..	0	..	1	..

MEATS ANALYSIS

% NH ₃ before cook	6.18	6.18	6.08	6.08	6.28	6.14
% H ₂ O before cook	8.3	8.6	9.4	10.1	8.9	9.2
% H ₂ O after cook	7.0	6.5	7.9	6.6	6.6	7.0

CAKE ANALYSIS

% H ₂ O	7.5	8.5	8.6	8.8	8.5	7.9
% Oil	6.65	5.98	6.25	5.69	6.07	5.68
% NH ₃	8.38	8.39	8.37	8.36	8.48	8.40
Standard	79.3	71.2	74.7	68.0	71.6	67.6
Color No.	1	2	6	5	3	4

REFINING TEST

% NaOH solution	6.2	6.2	6.2	6.2	6.2	6.2
Degree Baume ...	14	14	14	14	14	14
% Loss	5.1	5.1	5.8	5.6	8.0	7.8
Color	35Y 4.1R	35Y 4.1R	35Y 4.3R	35Y 4.5R	35Y 4.8R	35Y 5.0R
3% official earth bleach	20Y 1.7R	20Y 1.7R	20Y 1.7R	20Y 1.7R	20Y 1.7R	20Y 1.8R

OIL ANALYSIS

% F.F.A.	1.03	.99	1.00	1.00	1.05	1.06
Color 1 in. cell...	50Y 26.0R	50Y 21.0R	50Y 21.0R	50Y 23.0R	50Y 18.0R	50Y 26.0R
% H ₂ O .....	.06	.05	.08	.10	.10	.09
% Gums .....	.40	.35	.47	.66	.52	.59
% Neutral oil...	98.51	98.61	98.45	98.24	98.33	98.26

Object of and Conclusion of Experiment No. 6

This Experiment had for its object to determine if the time elapsed between addition of moisture to ground meats and the beginning of the cook had any influence on the quality of oil produced.

It was found that by allowing the moistened meats to stand one hour in the bins the loss was increased 2.1%, while the refined and bleached color remained the same. The high standard of the meat run directly to the cooker without any storage time in the bins is as yet unaccounted for.

EXPERIMENT NO. 6

CONDITIONS

	1A	1B		1A	1B
Time of Cook Min.....	40	40	Rate of Direct Steam Ad-		
Temp. of Cook ° F.....	207	212	dition Lbs. Per Min.....	83	83
Jacket Pressure, lbs.....	40	40	Pressure of Direct Steam..	110	110
Minutes Allowed to Stand in Cooker Bins.....	60	0	Temp. of Preheat ° F.....	165	165
			Form of Moisture Addition Before Preheater.....	Steam	Steam

(Table 6—Continued)

SEED ANALYSIS

% H ₂ O	8.5	8.4	% FFA in Oil in Seed.....	1.40	1.20
% Oil	19.62	20.12	% Damage	1	0
% NH ₃	4.32	4.32	% Immature	1	1

MEATS ANALYSIS

% NH ₃ Before Cook.....	6.08	6.08	% H ₂ O After Cook.....	6.4	6.2
% H ₂ O Before Cook.....	9.0	8.6			

CAKE ANALYSIS

% H ₂ O	7.5	7.9	Standard	70.3	90.4
% Oil	6.00	7.51	Color No.	2	1
% NH ₃	8.53	8.31			

REFINING TEST

% NaOH Solution.....	7.0	7.0	Color	35Y 5.7R	35Y 5.8R
Degrees Baume	14	14	3% Official Earth		
% Loss	9.1	7.0	Bleach..	20Y 2.8R	20Y 2.7R

OIL ANALYSIS

% FFA.	1.71	1.61	% Gums .....	.68	.66
Color 1 in. Cell.....	..	..	% Neutral Oil.....	97.54	97.67
% H ₂ O .....	.06	.07			

EXPERIMENT NO. 6A

In order to account for the excess loss of test 1A over 1B in Experiment No. 6, two additional refinings were made some time later on the oils of these two tests; the soap stocks analyzed and the loss divided into its constituent parts.

	1A	1B		1A	1B
% F.F.A.	1.60	1.55	% Loss Due to F.F.A.....	1.60	1.55
% Lye	7.0	7.0	% Loss Due to Materials		
Degree Baume	14	14	Not Fat.....	1.20	.80
% Loss	9.8	6.4	% Loss Due to Saponifica-		
% Moisture in Soapstock..	39.01	47.80	tion	2.02	2.49
% Neutral Oil in Soapstock	29.64	11.75	% Loss Due to Neutral Oil		
% T.F.A. in Soapstock....	51.24	41.75	Emulsified	4.98	1.56
% NaOH in Soapstock....	3.61	4.68	Analyzed Loss Not Fat....	1.40	1.09

The excess loss is due to the presence of some emulsifying agent.

Object of and Conclusion of Experiment No. 7

Experiment No. 7 was performed to determine the effect of the addition of water to meats before cooking under two cooking conditions employing 30 and 70 pounds jacket pressure. The experiment shows that when using 30 pounds jacket pressure the best extraction is obtained when the moisture content of meats was

raised to 10%. The loss on refining decreased as water addition increased.

Employing 70 pounds jacket pressure the best extraction was obtained by increasing the moisture in meats to about 9%, although here the variation in standard was very little. The quality of crude showed improvement over that produced from unwetted meats, but showed no variation with increasing moisture content.

EXPERIMENT NO. 7

CONDITIONS

	1A	1B	1C	2A	2B	2C
Time of cook min.....	40	40	40	40	40	40
Temp. of cook ° F.....	209	209	205	214	215	215
Jacket pressure lbs.....	30	30	30	65	65	65
Rate of direct steam addition lbs. per min.....	83	83	83	83	83	83
Pressure of direct steam..	110	110	110	110	110	110
Form of moisture addition before preheater.....	Dry	Water	Water	Water	Water	Water
Temp. of preheated seed..	None	None	None	None	None	None

SEED ANALYSIS

% H ₂ O	8.8	8.8	8.8	8.3	8.0	8.3
% Oil	19.65	20.50	20.34	19.52	19.80	20.22
% NH ₃	4.38	4.40	4.40	4.35	4.36	4.45
% F.F.A. in oil in seed..	1.15	1.50	1.15	1.70	1.30	1.75
% Damage	0	0	0	2	0	2
% Immature	2	2	6	2	3	0

MEATS ANALYSIS

% NH ₃ before cook.....	6.13	6.28	6.05	8.45	6.33	6.48
% H ₂ O before cook.....	7.2	10.1	12.3	8.7	10.2	11.0
% H ₂ O after cook.....	6.8	9.1	10.9	6.3	7.5	7.8

CAKE ANALYSIS

% H ₂ O	7.0	9.3	10.0	7.2	7.5	7.8
% Oil	9.10	6.20	6.96	6.05	6.16	6.34
% NH ₃	8.59	8.67	8.53	8.88	8.90	8.83
Standard	105.8	71.5	81.5	68.1	69.3	71.8
Color No.	1	2	3	1	2	3

REFINING TEST

% NaOH solution	7.0	7.0	7.0	7.0	7.0	7.0
Color	35Y 5.7R	35Y 5.7R	35Y 5.6R	35Y 6.2R	35Y 6.2R	35Y 6.2R
Degree Baume	14	14	14	14	14	14
% Loss	6.8	6.0	5.4	6.4	6.4	6.3
3% official earth bleach..	20Y 2.7R	20Y 2.8R	20Y 2.7R	20Y 3.1R	20Y 3.0R	20Y 3.1R

OIL ANALYSIS

% F.F.A.	1.65	1.42	1.29	1.73	1.64	1.67
Color 1 in cell.....	50Y 47.0R	50Y 41.0R	50Y 43.0R	50Y 76.0R	50Y 73.0R	50Y 83.0R
% H ₂ O .....	.09	.11	.08	.08	.06	.08
% Gums .....	.88	.69	.43	.90	.87	.84
% Neutral oil	97.37	97.78	98.20	97.29	97.43	97.41

Object of and Conclusion of Experiment No. 8

The object of Experiment No. 8 was to compare the use of high and low jacket pressure, or high and low temperature cooking.

The results show in all three cases a slightly lower loss that is

in favor of the low jacket pressure.

Where water is added to the meats there is an improvement in color of oil and a slight decrease in extraction with the low jacket pressure. When the meats are cooked without previous addition of water the reverse is true.

EXPERIMENT NO. 8						
	1A	1B	2A	2B	3A	3B
<i>CONDITIONS</i>						
Time of cook min.....	40	40	40	40	40	40
Temp. of cook ° F.....	202	212	206	213	209	215
Jacket pressure lbs.....	30	70	30	70	30	65
Rate of direct steam addition lbs. per min.....	27	27	83	83	83	83
Pressure of direct steam...	110	110	110	110	110	110
Form of moisture addition before preheater	Dry	Dry	Dry	Dry	Water	Water
<i>SEED ANALYSIS</i>						
% H ₂ O	9.0	9.3	9.1	8.7	8.8	8.0
% Oil	20.35	21.20	20.80	20.80	20.50	19.80
% NH ₃	4.17	4.09	4.30	4.16	4.40	4.36
% F.F.A. in oil in seed...	1.25	1.30	1.15	1.40	1.50	1.30
% Damage	1	3	2	1	0	0
% Immature	1	2	2	1	2	3
<i>MEATS ANALYSIS</i>						
% NH ₃ before cook.....	5.73	5.60	5.73	5.78	6.28	6.33
% H ₂ O before cook.....	8.1	7.9	8.2	7.6	10.1	10.2
% H ₂ O after cook.....	8.0	7.3	8.3	7.7	9.1	7.5
<i>CAKE ANALYSIS</i>						
% H ₂ O	7.9	7.3	8.0	7.3	9.3	7.5
% Oil	5.60	5.86	5.65	6.00	6.20	6.16
% NH ₃	7.67	7.53	7.57	7.75	8.67	8.90
Standard	73.0	77.8	74.7	77.5	71.5	69.3
<i>REFINING TEST</i>						
% NaOH solution	7.0	7.0	7.0	7.0	7.0	7.0
Degree Baume	14	14	14	14	14	14
% Loss	5.4	5.8	5.1	5.4	6.0	6.4
Color	35Y 6.0R	35Y 5.5R	35Y 6.0R	35Y 5.0R	35Y 5.7R	35Y 6.2R
3% official earth bleach...	20Y 2.6R	20Y 2.2R	20Y 2.5R	20Y 2.2R	20Y 2.8R	20Y 3.0R
<i>OIL ANALYSIS</i>						
% F.F.A.	1.29	1.57	1.32	1.40	1.42	1.64
Color 1 in. cell.....	50Y 30.0R	50Y 30.0R	50Y 26.0R	50Y 43.0R	50Y 41.0R	50Y 73.0R
% H ₂ O .....	.06	.10	.10	.06	.11	.06
% Gums .....	.59	.58	.52	.40	.69	.87
% Neutral oil	98.06	97.75	98.06	98.14	97.78	97.43

Object of and Conclusion of Experiment No. 9

The object of Experiment No. 9 was to determine if there was any difference in the oil flowing from the press at different stages of pressing.

The oil from the first and last stages was caught separately and compared with the total oil from another press filled from the same cooker. The results showed some difference in that the first oil gives a lower loss than the last flowing from the press.

EXPERIMENT NO. 9

	Number 1			Number 2		
	First Oil from Press	Last Oil from Press	Total Oil	First Oil from Press	Last Oil from Press	Total Oil
% F.F.A.	1.39	1.45	1.39	1.32	1.34	1.40
% H ₂ O .....	.07	.05	.07	.08	.10	.06
% Neutral oil	98.03	97.80	98.00	97.99	97.96	98.14
% Gums .....	.51	.70	.45	.61	.58	.40
% Lye	7.0	7.0	7.0	7.0	7.0	7.0
% Baume	14	14	14	14	14	14
% Loss	8.6	8.9	9.0	4.9	6.0	5.4
Color	35Y 5.7R	35Y 5.5R	35Y 5.5R	35Y 5.5R	35Y 5.3R	35Y 5.0R
Bleach	20Y 2.5R	20Y 2.4R	20Y 2.4R	20Y 2.2R	20Y 2.2R	20Y 2.2R

Discussion of Results

The experimental work given here is to be considered in the light of a preliminary survey to determine the advisability of further investigation. This Committee would hesitate at this time to advance any theories on the correct cooking of prime cottonseed meats. There are, however, a few points of interest brought out in this work.

In the experimental work above a neutral oil determination by Dr. Wesson's method is included. This method of analysis was not found of any particular value in predicting or accounting for the loss on refining. In some cases, as in Experiment No. 7, the loss on refining seemed to decrease with a decrease in materials not fat (reported as gums) and with increasing neutral oil content. In other experiments it fails or only slightly accounts for an increase of loss as much as 3%.

A comparison of titrated free fatty acid in oil produced in the mill from a certain seed with that shown by the oil extracted from the seed according to the official method showed close agreement. In 47 tests there were five perfect checks; nine within variation of .10; ten within .10 and .20; eleven within .20 and .30; seven within

.30 and .40; three within .40 and .50; and two over 0.50%; with a maximum of variation of .71. Average showed F. F. A. Oil 1.41, F. F. A. seed 1.28.

No conclusions could be drawn as to all the factors determining the color of meal produced. This color is, however, greatly influenced by the amount of water added to the meats before cooking and to the method and amount of heat application.

It is seen that by variation of cooking methods or procedures within usual practical limits it is possible to get the same yield of oil and still have an oil varying as much as 3% in refining loss. The proper cooking of Cotton Seed Meats seems to be a process depending upon the regulation of several, variable such as moisture, in what form and when applied; the temperature attained by the meats; the rate and time of heating and the means of heat application.

The committee is of the opinion that this process offers a valuable field for investigation; that the work, if possible, should be reduced to a more absolute basis than reported in this survey and that it be continued on this and extended to other types of seed usually met with in oil milling.