The unisomerized methyl esters isolated from a sample of freshly cut alfalfa also showed a large amount of absorption at 3160 Å. The large absorption was therefore not due to the production of partially oxidized or polymerized linolenic acid during the process of dehydration.

Discussion

The contribution of alfalfa lipids to the total dietary fat intake is small as standard animal and poultry feeds usually do not contain more than 10% dehydrated alfalfa leaf meal. However, their contribution may become significant when animals and poultry are pastured on alfalfa, as is usually practiced with hogs and turkeys. Furthermore, Richardson and Abbott (27) found that when dairy cows were fed exclusively on alfalfa a crumbly butter resulted, which seemed similar to the results obtained when dairy cows were restricted to feeds containing too much oil meal.

A large amount of absorption of the unisomerized methyl esters seemed to be due to an unidentified faintly yellow compound. This was not extracted with the nonsaponifiable material. Furthermore it could not be removed from the methyl esters by high vacuum distillation. It is possible that this or a similar compound is partly responsible for the difficulties encountered in the spectrophotometric analysis of natural oils such as linseed oil.

Summary

Freshly dehydrated alfalfa leaf meal was repeatedly extracted with acetone, ethyl alcohol, and Skellysolve B in a percolator at room temperature; 6.59% of crude extract was obtained. This extract was composed of 3.7% phospholipids, 33.2% triglycerides, 17.2% crude wax, 8.3% unsaponifiable, and 37.6% water soluble material.

Spectrophotometric analysis of the mixed methyl esters from the triglyceride fraction indicated the presence of 32.2% linolenic, 16.9% linoleic, 31.0% oleic, and 19.9% saturated acids. The mixed methyl esters from the phospholipid fraction contained 35.2% linolenic, 14.7% linoleic, 36.8% oleic, and 13.3% saturated acids.

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Processing of Cottonseed. IV. Effect of Preparation and Cooking of Meats on the Bleach Color and Storage Properties of Screw-Pressed Oils[1]

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Introduction

AS THE result of a series of mill-scale tests previously reported (1, 2), it was found that hydraulic-pressed oils had lower initial bleach colors,[3] which increased less rapidly during storage than did those of screw-pressed oils produced from the same seed. The lower bleach color of the hydraulic-pressed oils was attributed to the presence of water added to the meats during cooking prior to pressing. It was postulated that the presence of moisture during cooking of the meats caused deep-seated changes in the pigments contained in the water-sensitive pigment gland walls. It was therefore predicted that non-reverting[4] screw-pressed oils of low bleach color could be produced by wet-cooking of the meats prior to expression of the oil.

Conditions during preparation and cooking of the meats prior to expression of oil which might affect the bleach color of the oils are as follows:

1. Particle size of meats: a) whole, b) ground, c) rolled.
2. Moisture in the meats: a) originally, b) added before and during cooking.
3. Cooking conditions: a) temperature, b) duration of cooking, c) extent of agitation during cooking, d) venting during cooking.

[1] Presented before the 54th Annual Meeting of the National Oil Mill Superintendents' Association, Dallas, Texas, June 9-11, 1948.

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[3] The term "bleach color" is used to designate the residual color, in terms of Lovibond red and yellow units of an oil which has been alkali-refined and bleached by American Oil Chemists' Society official methods.

[4] "Non-reverting oils" are oils which do not develop high bleach color during storage at moderate temperatures.

Conditions during expression of the oils from cooked meats which may affect the bleach color of screw-pressed oils are as follows:

1. Moisture in the cooked meats.
2. Temperature of a) cooked meats, b) shafts, c) cages, d) expressed crude oils.
3. Pressure resulting from changes in a) rate of feed, b) setting of the slots in the cages.

During the investigation it has been possible to vary a number of the aforementioned processing conditions and determine effect of these variations on the bleach color and rate of reversion of screw-pressed cottonseed oils.

Experimental

Methods of Analysis. The samples of meals and oils which were collected at the mills were analyzed, and the oils were refined and bleached by American Oil Chemists' Society official methods. Samples of oils prepared on a laboratory scale were refined and bleached by use of a small scale modification (3) of the American Oil Chemists' Society official methods.

Absorption spectra of chloroform solutions of the crude and refined oils were measured with a Beckman quartz spectrophotometer. The concentrations of gossypol in the oils and cooked meats were determined by application of the alkaline extraction and the antimony trichloride-spectrophotometric method to chloroform solutions of the oils and to aqueous ethanol extracts of the meals (4).

Laboratory Experiments

A preliminary series of cooking and pressing experiments was carried out on a laboratory scale to determine the optimum amount of water which should be added to the meats before cooking. For this purpose three batches of flakes, 0.007 to 0.008 inches thick, were prepared from a single lot of prime cottonseed. The flakes were stored in closed cans at 38°F. for periods not exceeding 10 days between preparation and processing of each lot of flakes. Determination of the content of moisture and pigments of the flakes indicated that the three batches were essentially uniform.

Experiments were carried out with one-kg. samples of the flakes which were cooked in aluminum pans 13.5 x 8.25 x 2.5 inches covered with aluminum lids. Wetting of the meats was accomplished by spraying water over successive thin layers of the flakes, followed by manual stirring of the moistened flakes. The covered pans containing the flaked meats were placed in a forced draught, electrically heated and thermostatically controlled oven. During the first half-hour of cooking the pan was usually kept covered to simulate conditions in the first stack of a commercial cooker. The lids were then removed to permit moisture to escape. The flakes were thoroughly stirred at 15-minute intervals during cooking.

Oil was expressed from the cooked meats in a preheated (200°F.) Elmes press fitted with a Carver No. 4 head assembly (2.5 in. diam.) and slotted cage. Strips of 0.009 inch thick metal were inserted in the relatively wide slots (0.025 in.) of the cage to prevent extrusion of the meal. Pressure was applied by manual operation of the hydrostatic pump. The pressure was built up in successive stages; each pressure was maintained until oil was no longer forced out; after this the pressure was increased. The maximum pressure obtainable with the press was approximately 2,350 lb./sq. in. on the cake, but in the case of some of the wet-cooked meals, the maximum pressure could not be applied because of extrusion of the meal.

Results. These experiments indicated that oils having the darkest bleach color were obtained from meats cooked without addition of water at high temperatures whereas addition of relatively large amounts of water, followed by cooking at 235-244°F. for 1.5 hours, produced oils having the lightest bleach color. It was also noted that, in the case of meats cooked without any added water or with 5% or less of added water, relatively high pressures were necessary to express the oil. However, most of the oil was expressed at very low pressures from meats which had been cooked after addition of 10-15% of water which is the basis of the forepressing operation employed in the Skipin process (5, 6).

Another series of experiments was made to determine the optimum amount of water which should be added to meats before cooking at 235-244°F. for 1.5 hours. The results which are summarized in Table I show that, under the cooking conditions used, addition of 10, 15, and 20% of water to the meats prior to cooking reduces the bleach color of the expressed oils; the greatest reduction occurred with the addition of 10% water.

TABLE I

Effect of Addition of Water Prior to Cooking Meats 1.5 Hours at 235-244°F.[1]

Water added[2] %	Gossypol in cooked meats[3] %	Crude oils: Gossypol %	Crude oils: Specific extinction coefficient at 363-372 mμ $E^{1\%}_{1cm.}$	Crude oils: Absorption calculated for gossypol at 364-366 mμ[4] $E^{1\%}_{1cm.}$	Bleach color, Lovibond red units[5]
0	1.48	0.26	1.26	0.92	5.96
10	1.06	0.23	1.06	0.81	0.94
15	1.02	0.23	1.12	0.81	2.88
20	0.78	0.25	1.30	0.88	2.22

[1]All results except those for sample without added water are the average from two experiments.
[2]Original moisture content, 9.4%.
[3]Original gossypol content, 2.31%.
[4]Absorption calculated as 352 times the percentage of gossypol in the oil, where 352 is $E^{1\%}_{1cm.}$ at 364-366 mμ of pure gossypol.
[5]Cell length 5¼ inches.

The amount of unchanged gossypol in the cooked meats was found to decrease proportionally to the increase in the amount of water added prior to cooking. However, the amount of gossypol in the crude oils appeared to be relatively constant, and as previously reported (1, 2, 3) there does not appear to be any correlation between the bleach colors of the expressed oils and their contents of gossypol. Based on the position of the absorption maxima and the poor correlation of the specific extinction coefficients of the crude oils at their absorption maxima compared with the values calculated for pure gossypol at its absorption maximum, it can also be concluded, as previously pointed out (1, 2), that the pigments of the crude oils which are responsible for the color in the bleached oils are modified forms of gossypol rather than the original pigment.

Samples of the cooked meats were examined with a microscope under low power to determine changes in the color and condition of the glands and the extraglandular tissue. The cooked meats were also

treated with water in order to compare the reaction of the heated glands with that of the glands in the original uncooked flakes. The pigment glands in the uncooked flakes varied from orange to red-purple in color. Flakes treated with water indicated that the contents of the orange-colored glands were expelled in streams of orange-brown suspended particles. Purple-colored glands were more resistant to rupture, but streams of purple particles were ejected upon treatment with water. The extra-glandular tissue was lightly colored, and the reticular network about the glands was particularly dense.

The glands in all samples of cooked meats ranged in color from yellow to orange to purple. Yellow glands were more prevalent in the meats which had been cooked with 20% of added water whereas the darker colored pigment glands were more numerous in the meats cooked with smaller amounts or no added water.

As the amount of water added prior to cooking was increased, the number of ruptured glands increased. but no sample of cooked meats was observed in which all of the pigment glands were ruptured. The dry-cooked meats contained very few ruptured pigment glands whereas about 60% of the pigment glands were ruptured in meats which had been cooked with 20% of added water.

The glands in cooked meats were more resistant to rupture upon treatment with water than were the glands in uncooked flakes and, as in the case of the uncooked flakes, the purple glands were more resistant than the more lightly colored glands. The color of the streams of suspended particles which were emitted from the glands upon treatment with water varied from yellow to orange to purple.

The extraglandular tissue in the cooked meats was discolored, distorted, and sometimes contracted. The connective tissue was colored orange, yellow, and blue, and the amount of coloration was proportional to the amount of water added and the length and temperature of cooking.

On the basis of these observations, coupled with the relatively slight changes in gossypol content of the cooked meats (Table I), it was concluded that the conversion of native cottonseed pigments to more highly polar compounds during cooking of cottonseed in the presence of moisture is the result of reactions which occur within the pigment glands rather than in the extraglandular tissue as had previously been postulated (7).

MILL-SCALE TESTS

I. Effect of Water

Because of the inability to simulate plant-scale conditions in the laboratory it was considered essential to repeat the experiments in a commercial mill. The first mill-scale test was carried out in a mill equipped for pre-cooking in a stack cooker prior to expression of the oil in a continuous screw press. Conveyors were installed to connect the four-stack French pre-cooker with the tempering troughs of the continuous screw press of the Super-Duo type.[5]

The tests were carried out while the mill was operating at normal capacity. The feed rate of the flaked meats was approximately 3,960 lb./hr. All of the samples were collected from the same press. Spacings in the vertical barrel were set at 0.020, 0.015, and 0.010 inches and in the horizontal barrel at 0.015, 0.010, and 0.010 inches. The seed was taken directly from the seed house without selection. Two factors made evaluation of the results difficult: the seed was very heterogeneous with respect to the free fatty acid content of the oil; and it was uniformly lightly pigmented so that oils of initial low bleach color were obtained even when the meats were cooked at high temperatures without addition of water.

With the equipment available at the mill it was possible to vary the following conditions during cooking of the meats:

1. Amount of water added to the meats a) before rolling, b) before entering the stack cooker, c) in the first stack of the cooker (water and live steam added), and d) before entering the press.

2. Temperature during cooking of the meats by varying the steam pressure on the second stack of the cooker.

3. Drying the cooked meats by a) heating and venting in the third stack of the cooker, b) heating and venting in the fourth stack of the cooker, c) exposure of the meats in the conveyor, d) heating and venting in tempering troughs of the expeller.

Results. Since the processing data and results obtained in the thirty experiments which were carried out are too voluminous to include in the present report, only those for the extreme conditions of moisture and temperature during cooking are shown in Table II.

TABLE II

Meals and Oils from Dry- and Wet-Cooked Meats

Product	Water added none	Water added 11%
Cake		
Water, %	4.82	4.04
Oil, %	4.31	4.08
Gossypol, %	0.004[1]	0.014
Oil		
Free fatty acid, %	2.1	3.7
Gossypol, %	0.08[1]	0.23
Color after refining, Lovibond red.	6.6	7.6
Color after bleaching (Y)/(R)	20/2.5	20/2.7

[1]Very poor test for gossypol was obtained. The actual gossypol content was probably much less than that calculated on the basis on the absorption at 520 mμ of the antimony trichloride test (4).

For dry cooking, flaked meats were passed through the stack cooker, but with the steam turned off. They were then heated for approximately 15 minutes in the cooker and conditioner of the screw press, at 236 and 260°F., respectively.

For wet cooking, water was added to meats at the rate of 54 lb./hr. before rolling, 130 lb./hr. before entering the stack cooker, and 250 lb./hr. in the first stack of cooker to give a total amount of added water of approximately 11%. Since live steam at moderate pressure was also introduced into the first stack of the cooker, slightly more than 11% of water was added to the meats prior to cooking. The meats were held in the cooker for a total time of one hour at jacket steam pressures of 50, 40, and 40 psi., respectively. The meats were then held approximately 15 minutes in the cooker and conditioner of the screw press in which the temperatures were 222 and 250°F., respectively.

The bleach colors of the freshly expressed oils obtained by dry and wet cooking were approximately the same, but, as shown in Figure 1, the absorption spectra of the crude oils differed markedly. The crude oil prepared from dry-cooked meats exhibited a single

[5] The Super-Duo type of screw-press was used because of its availability at the mill where the experiments were carried out, and not because it was believed to be superior or inferior to any other type of screw-press.

smooth absorption band with maximum at 370-373 mμ whereas the absorption band of the crude oil prepared from wet-cooked meats had a slight maximum at 373-377 mμ and an inflection at about 365 mμ. The absorption band of the oil from dry-cooked meats was also very much higher than that of the oil from wet-cooked meats. On the basis of the previously reported correlation (2) between the absorption spectra of crude oils and their rates of reversion, it could be predicted that the oil from wet-cooked meats would revert less rapidly than the oil from dry-cooked meats.

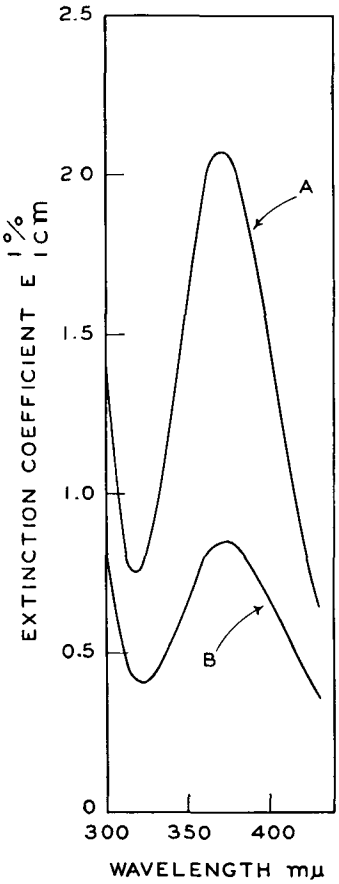

FIG. 1. Absorption spectra of crude screw-pressed oils from meats cooked (A) without addition of water and (B) after addition of 11 + % of water.

Upon storage of the crude oils it was found, as shown in Figure 2, that the oil from dry-cooked meats reverted more rapidly than that from wet-cooked meats. As previously noted (2), elevated temperatures increased the rate of reversion of both oils, but subsequent cooling of the reverted oils caused a decrease in the rate of reversion. It would appear, therefore, that cooling crude oils would be beneficial even though cooling was delayed for some time after expression.

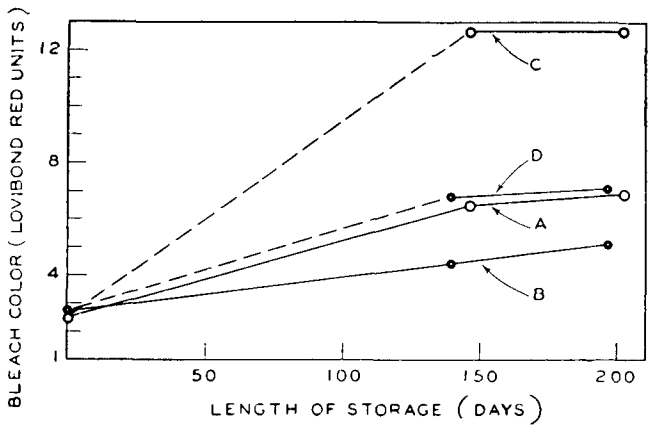

FIG. 2. Increase in bleach color during storage of crude oils from: (A) dry-cooked meats, oil stored at 76°F., (B) meats cooked with 11 + % of added water, oil stored at 76°F., (C) dry-cooked meats, oil stored 145 days at 85°F., then 52 days at room temperatures, (D) meats cooked with 11 + % of added water, oil stored as in (C).

As shown in Table III, the specific extinction coefficients of the freshly expressed and stored crude oils indicate that absorption at the shorter wavelength end of the absorption band increased less rapidly during storage of the initially more lightly colored oil than of the more deeply colored oil. It would appear, as previously postulated (2), that the material responsible for the color of bleached oils is produced by deterioration of the crude oil pigment which exhibits an absorption band in the wavelength region of 318 to 377 mμ. On the basis of these experiments it was concluded that cooking of meats in the presence of relatively large amounts of water would improve the storage properties of screw-pressed oils, but would not improve their initial bleach colors.

II. Effect of Cooking at Different Temperatures

The next tests were carried out at a mill where cottonseed was being processed by both the hydraulic and continuous screw press methods. Both the hydraulic- and screw-pressed oils being produced at the time had an initial bleach color lower than 2.5 Lovibond red.

TABLE III

Absorption Spectra Data of Stored Crude Oils Prepared from Dry- and Wet-Cooked Meats

Cooking conditions during preparation of oils			Storage conditions	Absorption minimum		Absorption maximum	
Water added %	Time min.	Temperature °F.		mμ	$E^{1\%}_{1cm.}$	mμ	$E^{1\%}_{1cm.}$
None	15	240 and 258-260	Stored one month at room temp.	317-318	0.74	368-374	2.07
None	15	240 and 258-260	Stored one month at room temp. and three months at 85°F.	318-320	0.85	370-373	1.99
11	60 15	220 and 222-250	Stored one month at room temp.	320	0.41	373-374	0.86
11	60 15	220 and 222-250	Stored one month at room temp. and three months at 85°F.	320-324	0.43	373-377	0.76

TABLE IV

Oils and Meals from Meats Cooked at Different Temperatures

Processing conditions			Oil in cake %	Refining loss %	Gossypol in crude oil[1] %	Effect of storage			
Type of meats	Water added %	Cooking temperatures				Time days	Free fatty acids %	Color of refined oil (Lovibond) red units	Color of bleached oil (Lovibond) Y/R units
Ground	0	High[2]	3.83	....	0.11	0	....	....	....
						27	0.9	6.8	20/3.3
						70	0.9	8.1	35/3.6
Rolled	0	High[3]	3.41	5.6	0.03	2	0.8	6.5	20/2.5
						26	0.9	7.0	20/3.4
						69	0.9	8.7	35/3.6
Ground	0	Low[4]	4.68	5.3	0.24	2	0.9	5.0	20/1.6
						26	0.9	5.8	20/2.1
						69	0.9	6.7	20/2.7
Rolled	0	Low[5]	4.27	5.3	0.24	2	1.0	5.1	20/1.6
						26	1.0	5.8	20/2.1
						69	1.0	6.2	20/2.6
Ground	6.2	High[6]	3.57	6.6	0.08	3	0.8	6.6	20/2.7
						27	0.9	7.4	20/3.4
						70	0.9	9.0	35/4.0
Rolled	7.4	High[7]	3.71	5.8	0.14	2	0.9	6.0	20/2.5
						26	1.0	6.8	20/3.0
						69	1.0	8.1	35/3.3

[1]All of the antimony trichloride tests were poor so that the actual concentrations of gossypol were probably very much less than the calculated values (4).
[2]Temperatures, 112, 206, 242, and 250°F., in stacks 1, 2, 3, and 4, respectively.
[3]Temperatures, 120, 210, 240, and 250°F., in stacks 1, 2, 3, and 4, respectively.
[4]Temperatures, 118, 160, 175, and 198°F., in stacks 1, 2, 3, and 4, respectively.
[5]Temperatures, 112, 130, 150, and 200°F., in stacks 1, 2, 3, and 4, respectively.
[6]Temperatures, 212, 236, 248, and 250°F., in stacks 1, 2, 3, and 4, respectively.
[7]Temperatures, 120, 210, 246, and 250°F., in stacks 1, 2, 3, and 4, respectively.

The hydraulic-pressed oils reverted only slightly whereas the screw-pressed oils reverted rapidly during storage at normal temperatures.

With the equipment available, which comprised a stack cooker and both hydraulic and screw presses, it was possible to determine the effect of the following conditions on the color reversion, namely, 1. rolling and grinding of the meats, 2. addition of limited amounts of water to the meats before cooking, and 3. cooking of the meats at high and low temperatures.

For the experimental runs the barrel spacings of a continuous screw press were held constant in order to limit the variations in experimental conditions to those caused by variation in cooking of the meats.

Ground meats prepared in a disc huller were used for one half of the experiment. Screen analysis of the ground meats were as follows:

Passed U. S. No. 20 screen and held on No. 40	67.7%
Passed U. S. No. 40 and held on No. 60	10.2%
Passed U. S. No. 60 and held on No. 80	11.1%
Passed U. S. No. 80 and held on No. 120	6.9%
Passed U. S. No. 120	4.1%
Total	100.0%

Rolled meats (0.015 in. average thickness) were used for the other half of the tests. In the two experiments in which the meats were wetted before cooking, water was added to the meats entering the first stack of the cooker. The percentage of water added was calculated on the basis of pounds of water added per hour and the pounds of cake produced in 5 minutes. Temperatures were taken with a thermometer in each stack and were regulated by controlling the pressure of the steam admitted to the jackets.

Results. The percentage of oil remaining in the cake and the characteristics of the freshly expressed and stored oils prepared from rolled and ground meats cooked under different conditions are shown in Table IV. No trace of gossypol could be detected in any of the cakes.

There did not appear to be any consistent difference in the oils or cakes produced from rolled or ground meats. Addition of water in the relatively small amounts during these experiments did not affect the cake or the freshly expressed oils. However, temperatures during cooking had an appreciable effect on the freshly expressed oils. Both samples of oil from seed cooked at high temperatures contained less gossypol and were of higher initial bleach color than the oils from seed cooked at low temperatures.

In all cases relatively large amounts of fine meal extruded from the presses with the oil, and the amount of oil left in the cake was undesirably high. The conditions were particularly true in the case of meats cooked dry at low temperatures. Further experiments will be required to determine conditions during cooking or pressing or both which will minimize extrusion of fine meal and residual oil in the cake without adversely affecting the quality of the oil.

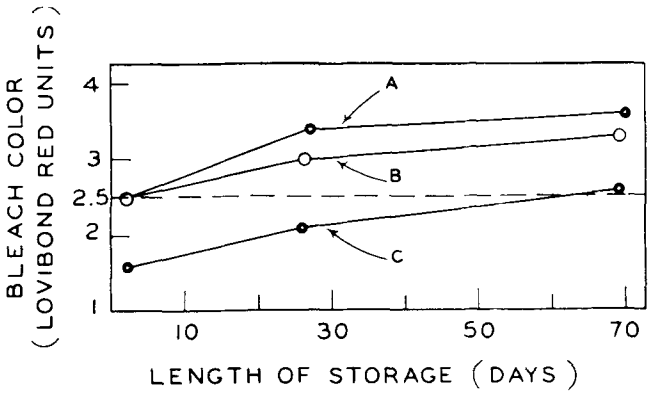

FIG. 3. Increase in bleach color during storage of crude oils from: (A) meats dry-cooked at high temperatures, (B) wetted meats cooked at high temperatures, and (C) meats dry-cooked at low temperatures.

As shown in Table IV and Figure 3, oils from meats dry-cooked at low temperatures reverted least rapidly, and those from meats dry-cooked at high temperatures reverted most rapidly. Oils from meats cooked with added water at high temperatures reverted less rapidly than those from meats cooked dry at high temperatures and more rapidly than oils from meats cooked dry at low temperatures. As shown in Figure 3, oils from meats dry-cooked at low temperatures did not develop bleach color beyond the allowable limit for prime oils until they had been stored at room temperature for approximately two months.

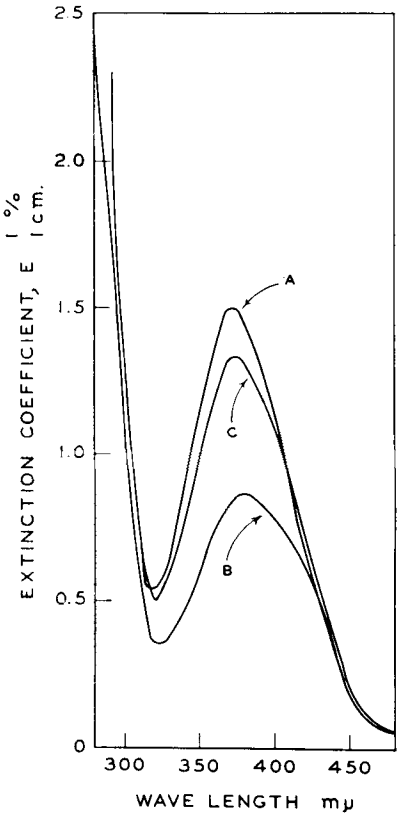

FIG. 4. Absorption spectra of crude oils from: (B) meats dry-cooked at high temperatures, (A) meats dry-cooked at low temperatures, and (C) wetted meats cooked at high temperatures.

As indicated by representative curves shown in Figure 4, the absorption spectra of the crude oils from meats cooked under different temperature and moisture conditions differed markedly from each other. The crude oil expressed from low temperature cooked meats exhibited a relatively high absorption maximum at 371-372 mμ with a shoulder at 400-410 mμ. The absorption maximum of the crude oil from meats dry-cooked at high temperatures (curve B) was lower than that of the crude oil from meats cooked at high temperatures with added water (curve C). The positions of the absorption maxima of these two oils were 375 and 380 mμ, respectively.

It can be seen from Figure 4 that the absorption spectrum of the crude oil produced by low temperature cooking was quite different from those produced by cooking at higher temperatures. It is also different from the absorption spectrum obtained with hydraulic-pressed oil as reported in a previous publication (1).

It may be concluded that crude oils processed under different conditions contain chemically different pigments. Of more immediate practical interest to the oil miller is the possibility of predicting the storage behavior of a given crude oil on the basis of the absorption spectrum of the oil at the time it is produced.

The absorption spectra of the refined oils prepared from stored crude oils exhibited approximately the same relationships as previously reported (1, 2). As shown in Table V, the absorption minimum at 388-396 mμ was relatively high in all cases but was lowest in the case of oils processed at the lower temperatures.

Summary

Results have been reported of an investigation of the effect of processing conditions on the characteristics of cottonseed meals and freshly expressed and stored crude oils produced by the continuous screw-press method of processing. The effect of cooking cottonseed meats under laboratory conditions and cooking the meats and expressing the oil under mill-scale conditions was investigated.

Conditions were varied with respect to 1. preparation of the meats, 2. addition of water to the meats before cooking, and 3. temperature and duration of cooking.

The laboratory-scale experiments showed that the addition of 10% water to the flaked meats prior to cooking at 235-244°F. for one and a half hours resulted in a low bleach color in the expressed oils. Deep-seated changes occurred in the pigments within the pigment gland walls during cooking. It was found that as the amount of water added prior to cooking was increased, the amount of gossypol in the cooked meats decreased, but the amount present in the expressed oils remained almost constant.

In the first series of mill-scale experiments in which auxiliary cooking was used it was found that the addition of relatively large amounts of water (11+%) did not improve the bleach color of the freshly expressed screw-pressed oils, but the oil from wet-cooked meats reverted very much less rapidly than that from

TABLE V

Absorption Spectra of Refined Cottonseed Oils from Crude Oils Stored for 24 Days

Crude oil	Specific extinction coefficients ($E^{1\%}_{1cm.}$)			
	Minimum at 388-396 mμ	Maximum at 404-412 mμ	Minimum at 414-420 mμ	Maximum at 424-432 mμ
From ground meats, dry-cooked at high temperatures (112-250°F.)	0.0126	0.0134	0.0130	0.0137
From rolled meats, dry-cooked at high temperatures (120-250°F.)	0.0120	0.0128	0.0124	0.0132
From ground meats, dry-cooked at low temperatures (118-198°F.)	0.00934	0.0108	0.0107	0.0120
From rolled meats, dry-cooked at low temperatures (112-200°F.)	0.00899	0.0105	0.0103	0.0116
From ground meats, wetted (6.2% added water), cooked at high temperatures (212-250°F.)	0.0135	0.0142	0.0137	0.0142
From rolled meats, wetted (7.4% added water), cooked at high temperatures (120-250°F.)	0.0119	0.0129	0.0127	0.0136

meats dry-cooked at high temperatures. However, the significance of the results of this test may be questionable since the great variation in the free fatty acid content of the oils indicated that they were obtained from very different seed.

In the second series of mill-scale experiments ground and rolled meats, wetted and unwetted, were cooked for 45 minutes at high and low temperatures. It was found that cooking non-wetted rolled or ground meats at low temperature resulted in low initial bleach color of the screw-pressed oils which reverted very little during storage at room temperature. The absorption spectra of these crude oils differed from those of other screw-pressed oils and hydraulic-pressed oils.

Widely varying amounts of gossypol were found in oils and meals produced from meats cooked under various conditions, but no direct relation was noted between any of the processing variables and the content of gossypol in the meals and oils or between the amount of gossypol in the expressed oils and their bleach colors before and after storage.

As previously reported, it was found that elevated temperatures during storage accelerated the increase in the bleach color of the expressed crude oils.

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☆ ☆ ☆ ABSTRACTS ☆ ☆ ☆

Oils and Fats

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A NEW METHOD FOR THE DETERMINATION OF FATTY ACIDS IN REFINING FOOTS AND SETTLINGS. J. M. Moreno. *Olii minerali, grassi e saponi, colori e vernici 25,* 56-8 (1948). The method comprises saponification, refining the soap, transferring into a Gerber bottle with H_2SO_4, and determining fatty acid similarly to a milk fat analysis.

SOME PROPOSALS TO SIMPLIFY THE DETERMINATION OF THE IODINE NUMBER ACCORDING TO THE GERMAN DISPENSATORY (DAB. 6). W. Awe, B. Skroch, and F. Demelius. *Suddeut. Apoth-Ztg. 88,* 155-8(1948). The German dispensatory uses the method of Winkler for the determination of the I number. Use is made of an I flask with a hollow stopper to hold HCl solution. The sample is weighed into the flask and dissolved in 2 cc. CCl_4. Ten cc. 0.5 *N* $KBrO_3$ solution and 1 g. KBr are added, and the hollow stopper is filled with 5 cc. of 25% HCl. The flask is closed tightly, the HCl being allowed to run into the mixture. The reaction is: $5KBr + KBrO_3 + 6HCl = 6Br + 6KCl + 3H_2O$. The flask is shaken almost constantly throughout the reaction time. (I number from 0-50, 5 minutes; from 50-100, 10 minutes; over 100, 15 minutes). Ten cc. of 10% KI is allowed to enter the flask slowly. The free I can be titrated with 0.1 *N* $Na_2S_2O_3$. If desired, 10 cc. 0.5 *N* arsenious acid can be used instead of the 10% KI, followed by two 5-cc. portions of 25% HCl, and the excess titrated with 0.1 *N* $KBrO_3$ solution. Designs for I flasks are given. (*Chem. Abs. 42,* 7658.)

COLOR REACTION OF HIGHER FATTY ACIDS. R. Goiffon. *Ann. biol. clin.* (Paris) *6,* 282(1948). The sulfate or chloride of Nile blue (I) produces a red color with neutral fats and a blue color with soaps. At pH 12, I turns red, but in the presence of soaps, such as the oleates, a complex is formed which raises the point of color change to pH 13. This reaction detects as little as 0.2 mg. Na oleate in a volume of 10 cc. It does not take place in the presence of alcohol or acetone. The color is proportional to the amount of oleic acid present and can be used for colorimetric determinations. It does not work for free fatty acids having one or more double bonds. (*Chem. Abs. 42,* 8110-11.)

COLORIMETRIC DETERMINATION OF PEROXIDE IN FATS AND OILS. H. Erdmann and F. Seelich. *Z. anal. Chem. 128,* 303-12(1948). Unfortunately any unsaturated compounds react with I_2 and cause error as do certain ketones, diketones, and oxy compounds. For this reason, E. and S. have proposed a method in which the sample is dissolved in water + methanol + benzene, the peroxide is made to react with $FeSO_4$ and the resulting Fe^{+3} is determined colorimetrically with NH_4CNS. The $FeSO_4/NH_4CNS$ system has been proposed by a number of others for determining peroxides. Detailed directions are given for preparing the color scale and for carrying out the analysis. The results obtained in the analysis of H_2O_2, succinic monoper acid, old butter, and old olive oil were very satisfactory. (*Chem. Abs. 42,* 6135-36.)

THE NATURAL INHIBITORS (OF OXIDATION OF OILS). K. Weber. *Arhiv Kem. 19,* 1-8. In order to determine the mechanism of the antioxidant effect of the tocopherols, the action of an oat-meal extract and of a commercial preparation of vitamin E on the autoxidation of iodoform in benzene solution in light of the wave length ranging between 623 and 334 mμ was studied. The action is attributed to negative catalysis. It is experimentally shown not to be due to light-filtering action or to chemical interaction of the inhibitor with the iodine liberated during the autoxidation. (*Chem. Abs. 42,* 7808.)

FURTHER STUDY OF THE ANTIOXYGEN PROPERTIES OF CERTAIN CAROTENOIDS. A. Herisset. *Bull. soc. chim.*