

# The Chemical Composition of Cottonseed Oil From the Upland Type of Seed

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**A**N investigation of the composition of the oil expressed from the Sea Island type (long fiber) cottonseed grown in Louisiana during the 1919 season has been previously reported<sup>1</sup>. Recently the composition of the oil expressed from the Upland type (short fiber) has been determined in order to compare the composition of the oils contained in the seeds from these two types of cotton. The oil from the Upland seed grown in Mississippi during the 1926 season was expressed hot in the laboratory by an oil expeller.

## Chemical and Physical Characteristics

The oil was refined according to the official method of the Interstate Cottonseed Crushers' Association. The more important chemical and physical characteristics of the crude and refined oil are recorded in Table I. The percentages of saturated and unsaturated acids

were determined by the lead salt-ether method<sup>2</sup> and corrections were made for the small quantity of unsaturated acids that contaminated the saturated acid fraction. The percentage of neutral oil in the crude as determined by the Wesson method<sup>3</sup> was 96.41.

## Unsaturated Acids

It was shown in the Sea Island oil investigation that the unsaturated acids fraction of cottonseed oil consists of oleic and linolic acids, and that linolenic acid is not present. The percentage composition of the unsaturated acids of the Upland oil was calculated from the theoretical iodine numbers of oleic acid (90.1) and linolic acid (181.4) and the determined iodine number of the unsaturated acids fraction (144.4), with the following results:

	Per cent	In original oil Per cent	Glycerides in original oil Per cent
Oleic acid . . . .	40.53	29.18	30.5
Linolic acid . . .	59.47	42.82	44.8
	100.00	72.00	75.3

TABLE I. UPLAND TYPE COTTONSEED OIL. CHEMICAL AND PHYSICAL CHARACTERISTICS

	Crude Oil	Refined Oil
Specific gravity 25°/25° . .	0.9230	0.9174
Refractive index, 20° . . . .	1.4745	1.4725
Acid value . . . . .	2.9	0.1
Iodine number (Hanus) . . .	106.8	108.2
Saponification value . . . .	199.3	195.0
Unsaponifiable matter (%) . . .		0.9
Saturated acids as determined (%) . . . . .		24.1*
Unsaturated acids as determined . . . . .		71.2
Iodine number of unsaturated acids . . . . .		144.4
Saturated acids (corrected) (%) . . . . .		23.3
Unsaturated acids (corrected) (%) . . . . .		72.0

\* Iodine number 4.7.

## Saturated Acids

A quantity of the saturated acids, prepared by the lead salt-ether method, was esterified with methyl alcohol. The mixture of methyl esters was fractionally distilled under diminished pressure. The data for the distillation are

<sup>1</sup>J. Am. Chem. Soc., 42, 1197 (1920).

<sup>2</sup>J. Am. Chem. Soc., 42, 2398 (1920); Cotton Oil Press, 6, 1, 41 (1922).

<sup>3</sup>Jamieson and Baughman, Cotton Oil Press, 6, 4, 33 (1922); Wesson, J. Oil and Fat Ind., 3, 297 and 343 (1926).

TABLE 3. Upland Type Cottonseed Oil. Results of Analyses of Fractions Obtained by Distilling Methyl Esters of Saturated Acids

Arachidic Acid Grams	.....	.....	.....	.....	.....	0.56	0.56
Arachidic Acid Percent	.....	.....	.....	.....	.....	10.47	
Stearic Acid Grams	.....	.....	.....	.....	.....	3.91	10.01
Stearic Acid Percent	.....	.....	.....	.....	.....	73.02	
Palmitic Acid Grams	6.29	40.37	43.11	18.07	8.77	7.69	115.53
Palmitic Acid Percent	75.82	90.12	92.61	81.75	54.51	.....	
Myristic Acid Grams	1.52	1.21	.....	.....	.....	.....	2.73
Myristic Acid Percent	18.34	2.70	.....	.....	.....	.....	
Esters of Saturated Acids Mean Molecular Weight	264.9	269.3	270.3	273.1	280.2	301.9	
Esters of Unsaturated Acids Percent	0.58	1.09	2.33	4.58	11.56	12.44	
Mean Molecular Weight	265.0	269.6	270.9	274.1	281.8	301.2	
Saponification Value	211.7	208.1	207.1	204.7	199.1	186.3	
Iodine Number	0.8	1.5	3.2	6.3	15.9	17.1	
Fraction	1	2	3	4	5	6	

given in Table 2. The preliminary distillation was made from a 1-liter Claisen flask and resulted in seven fractions designated by the letters A to G and a residue. The preliminary fractions were re-distilled as indicated in the table and six fractions and a small residue obtained.

The iodine numbers which are measures of the contaminating unsaturated acids and the saponification values of the final fractions are given in Columns 2 and 3 of Table 3. From these data the mean molecular weight of the saturated acids esters in each fraction was calculated as explained in the report of the Sea Island oil investi-

TABLE 2. UPLAND TYPE COTTONSEED OIL. FRACTIONAL DISTILLATION OF METHYL ESTERS OF SATURATED ACIDS

(141.9 g. subjected to distillation)  
Preliminary Distillation at 6 mm. pressure

Fraction	Temperature °C.	Weight g.
A	168-9	21.15
B	170-1	22.50
C	171	22.00
D	171	22.45
E	171-2	22.60
F	172-7	20.65
G	177-84	6.72
Residue		3.85

Final Distillation at 2 mm. pressure

Fractions A and B added	1	149.54	8.30
Fractions C and D added	2	154-6	44.80
Fractions E and F added	3	156-61	46.55
Fractions G and residue added	4	161-4	22.10
	5	165-75	14.10
	6	176-210	5.36
Residue			0.26

gation and the results are recorded in Column 6.

These results indicate what saturated acid esters may be present in the fractions. The mean molecular weights of the saturated acid esters in Fractions 1 and 2 lie between the molecular weights of methyl myristate (242.3) and methyl palmitate (270.3) and suggest therefore that these two fractions contain these two esters. The result for Fraction 3 indicates that methyl palmitate is the only

saturated acid ester present in this fraction. The indicated constituents for Fractions 4 and 5 are methyl palmitate and methyl stearate (298.4) and for Fraction 6 methyl stearate and methyl arachidate (326.4).

In order to test the correctness of these deductions the free fatty acids were recovered from some of these fractions and the constituent saturated acids isolated by fractional crystallization from alcohol. Their identities were established by the melting points and by observing whether or not these melting points were lowered when the substances were mixed with equal quantities of the respective pure acids which they were suspected of being. By this method pure myristic and palmitic acids were isolated from Fraction 1, pure stearic acid from Fraction 5 and pure arachidic acid from Fraction 6.

The quantities present in the various fractions were calculated from the mean molecular weights of the saturated acid esters (Column 6 Table 3) and the theoretical molecular weights of the esters. The results are given in Columns 7-14, Table 3.

In Table 4, the percentage composition of the saturated acids is

given in Column 2, the percentages of the various acids in the original oil in Column 3, and the equivalent percentages of glycerides in Column 4.

TABLE 4: UPLAND TYPE COTTONSEED OIL, SATURATED ACIDS

Acid	Acids in Saturated Acid Fraction		Acids in Original Oil Per cent	Glycerides in Original Oil Per cent
	Grams	Per cent		
Myristic..	2.73	2.12	0.49	0.5
Palmitic..	115.53	89.68	20.90	21.9
Stearic...	10.01	7.77	1.81	1.9
Arachidic.	0.56	0.43	0.10	0.1
	128.83	100.00	23.30	24.4

### Summary

A study has been made of the composition of a sample of Upland type (short fiber) cottonseed oil and the results are given below. For comparison the composition of a sample of Sea Island type (long fiber) cottonseed oil is also given.

Glycerides of	Upland Type Cottonseed Oil	Sea Island Type Cottonseed Oil
Oleic acid.....	30.5	35.2
Linolic acid.....	44.8	41.7
Myristic acid.....	0.5	0.3
Palmitic acid.....	21.9	20.0
Stearic acid.....	1.9	2.0
Arachidic acid.....	0.1	0.6
Unsaponifiable matter....	0.9	...

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