Some Observations on the Increase of Free Fatty Acid in Cottonseed

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TABLE I

Time of Storage, Days	Car T.P. F.F.A., %	31033 Moist.,%	Car S.P. F.F.A., %	25522 Moist., %	Car. T.P. F.F.A., %	50724 Moist., %	Remarks
0	1.30	11.50	....	....	....	....	Eunice sample
1	....	....	....	....	2.25	13.83	Eunice sample
6	1.30	11.43	2.40	16.42	2.90	13.91	Houston sample
10	1.55	12.35	2.75	15.32	3.40	13.68	Can No. 1 at Room Temperature
13	1.55	12.89	2.90	15.66	3.30	14.25	Can No. 1 at Room Temperature
14	1.60	....	3.35	....	2.90	....	Can No. 1 at Room Temperature (Samples 25522 and 50724 apparently reversed)
16	1.50	12.36	2.85	15.15	3.15	13.99	Can No. 2 at Room Temperature
18	1.50	12.59	3.80	15.69	3.80	14.18	Can No. 2 at Room Temperature
20	1.60	12.17	4.25	15.27	3.90	13.93	Can No. 2 at Room Temperature
22	1.95	12.37	5.30	15.74	4.75	....	Can No. 2 at Room Temperature
22	2.00	....	4.45	....	4.80	....	So. Tex. retained samples at Room Temperature
24	1.95	12.65	4.55	16.17	4.45	14.31	Can No. 3 at Room Temperature
27	1.85	11.91	4.40	15.54	5.05	13.43	Can No. 3 at Room Temperature
29	1.90	12.44	5.00	15.38	6.00	13.79	Can No. 3 at Room Temperature
31	1.85	12.08	6.10	15.74	9.15	13.83	Can No. 3 at Room Temperature
34	2.10	12.35	8.45	15.63	12.50	14.32	Can No. 3 at Room Temperature
37	1.90	....	10.55	....	15.85	....	Can No. 3 at Room Temperature
35	1.95	....	4.25	....	4.05	....	So. Tex. retained samples at 46° F.
38	1.70	....	5.00	....	....	....	Can No. 4 at Room Temperature
52	1.40	....	11.60	....	11.20	....	Can No. 4 at Room Temperature
59	1.75	....	16.40	....	13.25	....	Can No. 4 at Room Temperature
64	1.60	....	18.25	....	....	....	Can No. 4 at Room Temperature
73	....	....	22.60	....	15.70	....	Can No. 4 at Room Temperature (Sample 31033 depleted)
80	....	....	....	....	16.70	....	Can No. 4 at Room Temperature (Sample 25522 depleted)
80	1.95	....	5.40	....	4.30	....	So. Tex. retained samples at 46° F.
87	....	....	....	....	18.30	....	Can No. 4 at Room Temperature
94	....	....	....	....	19.95	....	Can No. 4 at Room Temperature (Sample 50724 depleted)

In the 1930-31 season three samples of seed originating in Louisiana were stored in the laboratory in one-gallon compression top cans, free fatty acid determined at intervals over a period of three months. One can of each lot was also retained in a refrigerator room three weeks after the storage test was begun. The temperature of the chill-room being 46° F.

The results of the tests are given in Table I.

Last portion of sample 50724 showed considerable mould and contained worms. It is interesting to note that loss of moisture due to opening of containers in retained samples is almost negligible.

Continuing the investigation and bearing in mind the fact that many mills used forced draft in seed houses to reduce the moisture content and the subsequent heating of seed, samples of seed were placed in a forced draft oven at room temperature to determine if such treatment would tend to increase the free fatty acid in seed. From the results of the tests conducted in 1930 it appeared that the acid increase might be accelerated by the exposure of moist seed to the air. This could not be confirmed as subjecting samples of seed to the circulation of air at room temperature in the forced draft oven failed to produce an increase in 8 days' treatment.

A change in the above conditions was made by using a temperature of 101° C. Two samples of seed of same moisture content (10.6%) were divided in six portions each and dried in the forced draft oven at 101° C. One of the portions was removed at each ten minute interval and the free fatty acids determined. These results are as follows (refer to Official Method for the determination of free fatty acid in seed):

TABLE II

Minutes Exposed	Sample No. 6385, F.F.A.	Sample No. 6390, F.F.A.
0	0.40	3.45
10	0.50	3.75
20	0.60	4.00
30	0.55	4.10
60	0.55	4.20
120	0.55	4.30
180	0.65	4.30

An attempt was made to determine if all seed are subject to free fatty acid increase if moisture content is raised sufficiently. Sample were selected from storage in three general groups. These were: Group I, seed from 1931 season with low free fatty acid with varying moisture; Group II, seed from 1932 season with low free fatty acid and varying moisture; Group III, seed from 1932 season with very free fatty acid and moderate moisture content. The increase of the fatty acid during storage is shown as follows:

TABLE III

Sample No.	Stored (Months)	Moisture %	Original F.F.A., %	F.F.A. After Storage, %
Group I:				
5865	15	8.7	0.7	0.5
5901	15	10.7	0.6	1.0
5923	15	11.6	2.6	3.7
5935	15	12.3	1.0	2.5
6036	14	14.5	3.6	25.3
Group II:				
6409	7	7.8	0.3	0.7
6373	7	10.5	0.6	1.1
6405	7	13.0	0.5	1.1
6427	6	14.4	1.0	6.8
6407	7	16.9	0.9	Decomposed
6408	7	18.7	1.4	Decomposed
Group III:				

6458	5	12.0	1.7	3.6
6459	5	12.0	1.7	3.6
6537	5	12.2	2.0	3.3
6552	5	12.0	3.5	3.2
6533	5	13.0	5.7	9.8
6546	5	10.4	7.5	10.1
6564	5	10.7	10.5	12.8
6567	5	12.6	14.5	18.5

From the above analyses there appears to be no appreciable increase in fatty acid where the moisture is below 10 per cent. Seed containing as much as 14 per cent in every case showed a marked increase in fatty acid while between these moisture limits lies a margin in which the fatty acid may or may not increase. A group of seed of low moisture and low fatty acid content, after several months' storage, were stored in a moist atmosphere at room temperature to ascertain if such condition would prove conducive to the production of free fatty acid. Although little increase was noted at the end of one week's storage, all samples had increased to more than 10 per cent at the end of two weeks with considerable mould.

The foregoing test was repeated excepting that at the end of 15 days' exposure to the moist atmosphere, the samples were divided in two parts, one part remaining in the moist room while the other was heated to 175° F. for 4 hours and then stored in one-gallon compression top can. The following table indicates the inhibitive action of either the heating or the dehydrating of the sample during the stage of rapid increase of the fatty acid.

TABLE IV

Sample	A	B	C	D	E	F
5865	0.5	1.4	11.4	21.0	14.7	13.6
5901	1.0	1.8	12.0	22.0	14.3	15.0
5935	2.5	3.3	8.8	17.1	8.7	10.3
6552	3.2	4.1	6.7	20.4	8.3	8.7
6427	6.8	11.7	25.4	32.6	22.9	25.7
6546	10.1	13.6	15.4	22.8	16.2	17.9

A—Free fatty acid beginning of storage.
B—Free fatty acid after 7 days' storage in moist atmosphere at room temperature.
C—Free fatty acid after 14 days' storage in moist atmosphere at room temperature.
D—Free fatty acid after 17 days' storage in moist atmosphere at room temperature.
E—Free fatty acid after 15 days' storage with subsequent heating to 175° F. for 4 hours.
F—Same as E after 40 days' total storage.

Attempting to correlate the susceptibility of seed to decompose producing free fatty acid with the germinating power of the seed, six samples were heated to 175° F. for 8 hours to completely kill the germ followed by a two weeks' storage in the moist room to compare with the results obtained on similar seed without the pre-heating. Table V exhibits the marked difference in the two treatments.

TABLE V

——Without Pre-heating——			——With Pre-heating——		
Sample	Original F.F.A., %	After 14 Days' Storage, %	Sample	Original F.F.A., %	After 14 Days' Storage, %
5865	0.5	11.4	6323	1.2	24.4
5901	1.0	12.0	6441	1.5	27.6
5935	2.5	8.8	6331	1.9	28.7
6552	3.2	6.7	6328	2.6	29.2
6427	6.8	25.4	6455	2.8	22.8
6546	10.1	15.4	6564	3.1	25.1
Average	4.0	13.3		2.2	26.3

It would thus appear that live seed is more resistant to the action producing free fatty acid than sterile or otherwise damaged seed.

Conclusions

The foregoing tests were conducted in the laboratory to observe the tendencies of seed to form free fatty acid when subjected to certain atmospheric and temperature conditions. The results of individual tests are given in all cases to elicit a discussion from others who may have conducted similar tests in hopes of arriving at more definite conclusions or to arrive at properties which may be attributed as common to all cotton seed.

The following statements are to be taken merely as tendencies and by no means as conclusive.

Cottonseed having less than 10 per cent moisture will remain stable under ordinary storage conditions.

Seed of 10 to 14 per cent moisture may or may not remain stable while seed having 14 per cent or more moisture will deteriorate in storage with a rapid increase of free fatty acid.

Deterioration of high moisture seed is inhibited either by cold storage or by heating seed to reduce moisture content.

Seed pre-heated to 175° F. to kill the germ is more sensitive than live seed to the formation of free fatty acid in moist atmosphere.

More experimental work is necessary to prove whether or not all cotton seed will increase appreciably in free fatty acid when subjected to the pre-drying treatment as prescribed by the official method of the National Cottonseed Products Association for determining this constituent.

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California Apricot Oil

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IN view of the growing interest in the production of oil from the apricot kernels separated from the pits at the cracking plants in California, a chemical study of the oil has recently been undertaken. The more important chemical and physical characteristics, as well as the proportions of the fatty acids present in the oil as glycerides, have been determined.

As early as 1908 Frank Rabak[1] of the Bureau of Plant Industry, after a comprehensive investigation dealing with the possible utilization of waste fruit pits in California, called attention to apricot kernel oil, describing its chemical and physical characteristics, and pointing out its commercial possibilities. At that tme the annual accumulation of pits amounted to approximately 5,000 tons.

It is estimated that at the present time the cracking plants receive each season between 10,000 and 11,000 tons of pits from the apricot canning and drying industries. The kernels, which amount to about one-fourth the weight of the pits, usually contain from 40 to 45 per cent of oil. Although the larger portion of the kernels separated at the cracking plants is exported to Germany, Holland and Scandinavian countries, the remainder is used for the domestic production of oil, most of which is absorbed by the cosmetic industry. Before any marked increase in the local use of the kernels for the production of oil is warranted, new outlets for it must be found as the quantity taken by the cosmetic

[1]Peach, Apricot and Prune Kernels as By-Products of the Fruit Industry of the United States. Bul. No. 133 of the Bureau of Plant Industry, U. S. Dept. of Agriculture.