EFFECT OF DIFFERENT METHODS OF

DISINTEGRATION OF COTTONSEED ON SOME PROPERTIES OF THE CRUDE OIL

WITH SPECIAL REFERENCE TO HIGH MOISTURE SEED

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IN the northeastern sections of North Carolina cottonseed are bought in the lint or as some express it—seed cotton. This practice encourages the farmers to sell their cotton as early as possible after picking and results in an accumulation of high moisture seed at the mills and gins during the first few months of each season. In a normal season the moisture content of this first run of seed will vary from 12% to 15%; but following a wet growing season such as 1934, the moisture content will vary from 12% to 25%.

Both the hydraulic and expeller types of mills are used in crushing these seed. The usual process is followed in the hydraulic mill, that is, after hulling the meats are ground in a Bauer meats grinder, and pass through standard rolls and on to the cooker. In the expeller mill no meats grinder or rolls are used, the meats passing directly from the hullers to the cooker where the moisture is reduced to around 6% and from the cooker the meats are elevated to the heated conveyors over the expellers where the moisture is further reduced to around 3%.

From a study of the production reports of these two mills, covering several years operations, it was evident that the crude oil from the hydraulic mill was of a better grade than the expeller oil, when the run of seed were comparable. This fact is shown by the figures in Table I which were taken from an annual report and representing a normal season's crush.

TABLE I

Difference in quality of crude oil from the hydraulic and expeller mills. Season's average.

	Hydraulic Mill	Expeller Mill
Seed: Moisture	12.75%	13.70%
Avial. Oil	371 lbs.	369 lbs.
Ammonia	3.72%	3.72%
Crude Oil: F. F. A.	2.50%	2 50%
R. Loss	8.30%	9.30%
Red Color.	7.10	9.10

By comparing the quality of the crude oil from the two mills in September, 1934, when working high moisture seed it was apparent that as the moisture in the seed increased the difference in the quality of the crude oil from the two types of mills increased in favor of the hydraulic mill. The results from a test run to determine this difference is shown in Table II.

TABLE II

(Test run October, 1934)

Difference in quality of crude oil from the hydraulic and expeller mills when high moisture seeds are crushed.

	Hydraulic Mill	Expeller Mill
Seed: Moisture	19.64%	20.27%
Avial. Oil	305 lbs.	295 lbs.
Ammonia	3.00%	3.15%
F. F. A.	3.00%	2.80%
Crude Oil: F. F. A.	2.80%	4.20%
R. Loss	10.50%	15.40%
Red Color.	10.60	11.50

Experiments were started in the laboratory to determine if possible the cause of the difference in the quality, especially color, of the crude oil from the two mills. About the time these experiments were outlined the food chopper was adopted as official for grinding cottonseed meats in making the free fatty acid determination in cottonseed and it was noticed that the extracted oil from the meats ground in the food chopper was darker in color than oil from meats ground in either the Wiley and Bauer mill, and it was clearly seen that the effect of grinding meats in the food chopper and the expeller mill was similar. This led to the conclusion that the quality of oil from the expeller mill was due to mechanical disintegration of the meats. It was thought before that the increased color of the expeller oil was due to excessive heating of the meats before they enter the expeller. Therefore, it was decided to include in the experiment different methods of reducing meats in order to determine the effect on the color of the crude oil, also the effect of rolling and cooking. Samples of meats and oil were caught from a regular run from the two mills. As previously stated the meats in the hydraulic mill are ground in the Bauer meats grinder and in this experiment the raw meats were ground in the Wiley mill for comparison. Results of this experiment are shown in Table III.

TABLE III

The effect of rolling, grinding, cooking and expelling cottonseed meats on the color of the crude oil.

	Hydraulic Mill		
	Sample No. 1	Sample No. 2	Sample No. 3
	Raw meats ground in Wiley Mill	Rolled meats chopped fine with a spatula	Cooked meats (225 F.) chopped fine with a spatula
Moisture	10.56%	...	...
F. F. A.	4.94%	7.06%	4.96%
Color of extracted oil	20.0 R.	20.0 R.	38.0 R.
Color of crude oil			40.0 R.

Note: Oil extracted with cold petrolic ether and one-inch column of oil used for color reading.

The figures in Table III show that there is very little difference in the effect of grinding meats in the Bauer and Wiley mills on the color of the crude oil but there is a decided increase in color when meats are ground in the food chopper and the expeller mill.

It was also noticeable throughout the past season that the per cent

	Expeller Mill Sample No. 1 Raw Meats (moisture 10.86%) ground in		Sample No. 2 Cooked Meats		Sample No. 3 Meats Entering Expellers	
	F.F.A.	Extr. Oil Color	F.F.A.	Color	F.F.A.	Color
Wiley Mill	2.80%	23.1 R.	2.78%	43.0 R.	3.10	Poor Ext.-Cloudy
Bauer Mill	2.60%	23.2 R.	2.63%	Cloudy	...	Poor Ext.-Cloudy
Food Chopper	2.70%	40.0 R.	2.74%	56.0 R.	2.80%	50.0 R.
Crude Oil	3.70%	Color deeper than 60.0 Red.				

free fatty acids in the expeller oil were considerably higher than the free fatty acids shown by the seed analyses, while there was no unusual difference in the per cent of free fatty acids in the crude oil from the hydraulic mill, indicating that expelling may also cause an increase in free fatty acids and refining loss as well as color, especially when working high moisture seed.

SUMMARY

Both the expeller and hydraulic types of mills are used for crushing high moisture seed in the northeastern section of North Carolina. The quality of crude oil from the hydraulic mill is decidedly better than crude oil from the expeller mill, when the seed are comparable and as the moisture content of the seed increases the difference in quality of crude oil from the two types of mill is progressively greater in favor of the hydraulic mill.

The disintegration of cottonseed meats in the food chopper, used for the free fatty acid determination in cottonseed, and the expeller mill have a very similar effect on the color of the oil. Apparently the effect of expelling also causes an increase in free fatty acids and refining loss, especially when working high moisture seed.

THE COLOR AND SPECTRAL TRANSMITTANCE OF VEGETABLE OILS

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ABSTRACT

A SPECTROPHOTOMETRIC analysis of 125 vegetable oils, 111 of which are from the cotton seed, has been made as a rational physical basis for the discussion and development of improved methods for the color grading of oils. The lightness and chromaticity of all the oils, and their spectral transmittance from 440 to 720 mμ, are indicated in tabular form. Consideration is given to some difficulties inherent in the color grading problem, arising chiefly from the independent variation of the concentrations of several different pigments present in the oils. Color grading in terms of the Lovibond glass standards is discussed along with other abridged methods of colorimetry suggested by the data.

CONTENTS

I. INTRODUCTION

The color of crude and refined vegetable oils is an important contributing factor in the determination of their market value. For many years the commercial color grading of oils has been based entirely on the Lovibond system of glass standards. Many difficulties in the use of this system have arisen in practice, involving inherent properties of the system itself or as the result of the methods of application. Attempts to substitute colorimetric methods based on other material color standards have likewise failed to provide a satisfactory solution to the problem.

As a rational physical basis for the analysis and discussion of the problem, and for the ultimate establishment of a more desirable procedure in color grading, an extensive investigation was undertaken of the spectral transmission and colorimetric properties of vegetable oils, covering a wide range of color variation in cottonseed oils from different geographical sources, and a more limited range of variation in vegetable oils of different plant origin.

The present paper gives the results of this study and a discussion of some difficulties inherent in the problem. Inasmuch as the color of these oils is at present universally expressed in terms of Lovibond glasses, this color system is also extensively employed in the present paper for comparison purposes.

II. SOURCE AND DESCRIPTION OF OILS

The vegetable oils included in this investigation were generously supplied by various manufacturers, dealers, and individuals interested in the work[3]. Information is generally unavailable on details of the methods of processing, the chemical composition, and the exact geographical origin of these oils. For purely colorimetric purposes, however, it is believed that collectively they are fairly representative of the majority of the edible vegetable oils of commerce, at least of the cottonseed oils. Such oils vary in color from a light greenish yellow

[1]The spectrophotometric measurements of the oils were made between July 1915 and July 1920 under the immediate supervision of I. G. Priest with the coöperation and financial support of the Society of Cotton Products Analysts and the Interstate Cotton Seed Crushers Association. The author was employed by the above societies and detailed to the Bureau of Standards as research associate from July, 1915, to July, 1916. He was then appointed to the bureau staff. Reports involving some phases of this work have been published by Priest in the Cotton Oil Press, as follows: 3, 86 (1919-20) No. 3; 3, 37 (1919-20) No. 9; 4, 95 (1920-21) No. 3.

*Publication approved by the Director of the National Bureau of Standards of the U. S. Department of Commerce.

[2]The author acknowledges the assistance of W. B. Emerson and M. K. Frehafer on some of the early spectrophotometric work. Throughout the recent analysis and preparation of data (1934-35) he is indebted to H. J. Keegan for assistance in computational work and to K. S. Gibson, D. B. Judd, and G. W. Haupt for much supplementary data supplied for the purposes of this paper. These data include all spectrophotometric or colorimetric data on the spectrum and the Lovibond glasses.

[3]The donors include Armour and Company, Harris Abattoir (Toronto), Procter and Gamble, Peet Bros., Globe Soap Co., Refuge Cotton Oil Co., Swift and Co., The Fort Worth Laboratories, Southern Cotton Oil Co., Corn Products Co., Phoenix Cotton Oil Co., Portsmouth Cotton Oil Co., Gunns Limited (Toronto), Capitol Refining Co., Armstrong Packing Co., Trinity Cotton Oil Co., American Cotton Oil Co., Falkenburg and Co., Empire Cotton Oil Co., Temple Cotton Oil Co., Independent Cotton Oil Co., Sea Island Cotton Oil Co., Magic City Oil Co., Felix Paquin, T. C. Law, F. N. Smalley, David Wesson, and P. S. Tilson.