COTTON AS A FOOD CROP

By DAVID WESSON

Although cotton is not usually shown in statistical tables as a food crop, it is really a food crop of great importance. Statistics are interesting things to play with, and as a rule make dry reading, but they have to be resorted to at times to give us a proper sense of proportion.

The cotton crop for the season 1925-6 was close on to sixteen million bales of staple and eight million tons of cottonseed. Each bale of ginned cotton of five hundred pounds carries with it one thousand pounds of seed when it goes to the gin.

Table No. 1 shows the production of the leading food crops in bushels and tons. The statistics give them in bushels, but for comparative reasons they have to be reduced to tons.

TABLE I THE PRINCIPAL FOOD CROPS OF THE UNITED STATES, 1925

	Bushels	Tons
Corn	2,918,000,000	81,726,000
Oats	1,470,000,000	23,520,000
Wheat	697,000,000	20,093,000
Cottonseed	533,000,000	8,000,000
Potatoes	344,000,000	8,600,000
Barley	227,000,000	5,450,000
Rye	52,000,000	1,450,000

TABLE II. WEIGHTS PER BUSHEL AND BUSHELS PER TON

	Lbs.	Bu. per Ton		Lbs.	Bu. per Ton
Corn	56	35.80	Potatoes	50	40
Oats	32	62.50	Barley	48	41.6
Wheat	60	33.33	Rye	56	35.80
Cottonseed	30	66.66			

Table II shows the reason. Could we have any better argument for adopting the metric system?

Cottonseed is practically a small nut averaging 55 per cent kernel and 45 per cent shell or hull. The shell is similar in texture to that of the chestnut. The kernels are very rich in oil and protein.

For comparative purposes the contents of the whole seed are taken and the fat and protein values of the several crops are given as follows:

TABLE III PERCENTAGES OF PROTEIN AND FAT IN FOOD CROPS.

	Protein	Fat		Protein	Fat
Cottonseed	21.5	20	Barley	11.2	2.1
Wheat	13.2	1.6	Corn	10.6	6.5
Oats	12	6	Potatoes	2.0	.6
Rye	11.4	1.7			

The protein and fat values of the different food crops for the past year are given in table IV.

TABLE IV TONS OF PROTEIN AND FAT IN THE SEVERAL CROPS.

	Protein	Fat
Corn	8,662,956 Tons	5,312,840 Tons
Wheat	2,652,276 "	1,600,000 "
Oats	2,824,000 "	1,411,200 "
Cottonseed	1,720,000 "	321,488 "
Barley	610,400 "	114,450 "
Rye	165,300 "	24,650 "
Potatoes	172,000 "	51,600 "

To measure up the value of the relative importance of the above crops on a fat and protein basis, another table has been prepared, which shows cottonseed in the third rank of the great food crops. In looking at these comparisons, however, we must bear in mind that crops vary from year to year, and while cottonseed might show up third as a fat protein producer this year, it might drop to the fourth place in a year, when we only had a ten million bale crop. The following table is for the year 1925:

Corn	13,975,796 Tons	Barley	724,850 Tons
Oats	4,235,200 "	Potatoes	223,000 "
Cottonseed	3,320,000 "	Rye	189,950 "
Wheat	2,973,276 "		

With the figures given in the above tables, which were worked up from the data published by the Department of Agriculture, we can readily believe that cotton is a food crop of high rank. Let us see what we are doing to utilize it.

In 1826, Dr. Benjamin Waring established a paper oil and grist mill at Columbia, S. C., Georgia had an oil mill in 1923.

About 1878 the chemist came into the field, and since that time, one improvement after another has taken place in the refining of the oil and the preparation of the edible fats, until there is but a small field left in this country for the oil of the olive; while the lard of the hog has been equalled if not surpassed by the various excellent cooking fats now on the market made entirely from the once despised cottonseed. Without the oil of the cottonseed, there would not be enough cooking fats to go around with our constantly increasing population.

During the years of development which have brought cottonseed oil and its products to their present high state of perfection very little attention has been given to the meal, which the seed carries in greater quantity than the oil. It is believed that the day is fast coming if it is not here already when the meal now selling at $30 to $40 per ton will be made into as valuable a food product as the oil. There is no more fertile field right now for the chemist than the development of important valuable food material which is now used chiefly for feeding cattle and the manufacturer of fertilizers.

Let us face the problem fairly, and see what we are up against.

We will begin our analysis by going right straight back to the cottonseed.

The Cottonseed

We have talked a great deal about cottonseed in terms of tons. Let us take it into the laboratory and examine it with the microscope, and then by chemical analysis. Through the courtesy of Dr. Winton, an illustration shows a cottonseed in section, horizontally and longitudinally. The seeds are actually about three-eighths of an inch long. One hundred of them weigh 10 to 12 grams, according to the variety, and it takes 7 million about to make a ton. The plate shows us an outer hull with adherent fibers, surrounding the meat or kernel, consisting of the folded cotyledons or seed leaves. Little colored dots are seen all through the meats. These carry the dark coloring matter which comes out with the crude oil.

The second illustration shows an enlarged section and gives us a better idea of the cell structure. As might be expected, seed vary according to locality and climate. The following are typical analyses of Georgia and Texas seeds and also the yield of products:

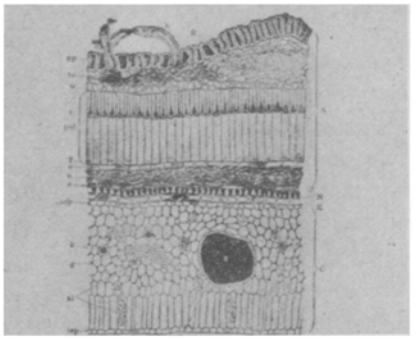
Cottonseed Analyses

	Georgia Per Cent	Texas Per Cent
Hulls	45.00	47.00
Meats	55.00	53.00
Oil in meats	37.00	31.20
NH_3 in meats	6.60	8.40
Protein in meats	36.99	43.50
Mill yields per ton of seed:	Pounds	Pounds
Cake	1,010.00†	1,056.00†
Oil	337.50	256.00
Linters	155.00	145.00
Hulls	375.00	515.00
Loss	123.00	100.00
†NH_3 in cake, per cent	7.16	8.00
Protein	44.5	50.00

In studying the analyses we will notice the high cake and the low hull yields. This is because in milling it is better practice to lose some hulls in the meat than meats in the hulls. These analyses made during the war, show very large lint yields which of course means that there was just that much less hull. Present practice since the war is to remove only about 100 lbs. of lint, thus making more hulls.

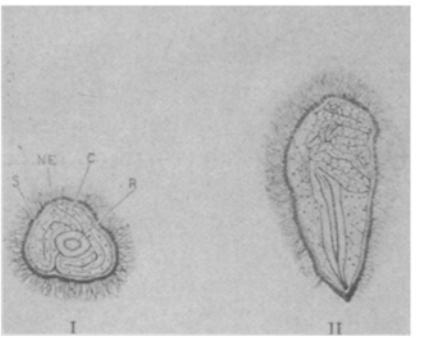
A further study of the analyses shows the large amount of protein in the cake which is mostly ground up and used as meal for cotton food. Investigations by O. Breese Jones, Bureau of Chemistry,[1] and Thomas B. Osborne and Lafayette Mendel[2], show that the protein of cottonseed is of a very high nutritive value.

In the present method of oil milling, the meal or cake carries about



COTTONSEED (CROSS SECTION)

S Spermoderm consists of cp Epidermis with hair, br Outer Brown Coat with R Raphe, w Colorless Cells, pal Palisade Cells, and b and c layers of Inner Brown Coat; N Perisperm; E Endosperm; c Cotyledon with p Outer Epidermis and icp Inner Epidermis; s Resin Cavity surrounded by z Mucilage Cells; al aleurone grains; k Crystal Cells; g Procambium Bundles.



COTTONSEED

I Transverse Section. II Longitudinal Section. S Spermoderm: NE Perisperm and Endosperm; C Cotyledons; R Radicle.

6 per cent oil and considerable gossypol. The oil in the cake grows rancid. The gossypol under certain conditions is poisonous, it imparts unpleasant flavor and the hulls are indigestible for humans.

It is possible to separate the meats of the cottonseed without the hulls, and to remove all its oil and gossypol by solvents, so as to obtain a product containing about 55 per cent protein. This protein makes a good meat substitute. With cottonseed meal costing $50 per ton carrying 50 per cent of protein, we get 1,000 lbs. of protein for $50 or our protein costs 5 cents per pound.

With beefsteak at 40 cents per lb. containing 20 per cent of protein, we pay $2.00 per lb. for the protein. Synthetic beefsteak is almost within the reach of the research chemist. Synthetic hash has already been produced, and it was good hash too.

Going on the theory that meat carries about 80 per cent water, the specially prepared cottonseed meal was mixed with three parts of water. which gave it the consistency of a very stiff porridge. This was mixed with potatoes and onions properly seasoned with salt and pepper and fried in cottonseed oil. It was impossible to tell the difference between this and good plain everyday hash.

There is on the market today a material sold and used as a beef extract for making beef tea, which is made by peptonizing the proteins of wheat. Is there anything extravagant in the idea that a valuable meat substitute should not be made from the protein of cottonseed?

[1] Poteins of the Cottonseed, D. Breese Jones and Frank A. Csonka, The Journal of Biological Chemistry, Vol. LXIV, No. 3, July, 1925.

[2] The Use of Cotton Seed as Food, Thomas B. Osborne and Lafayette B. Mendel, The Journal of Biological Chemistry, Vol. XXIX, No. 2, March, 1917.