

Carbohydrates Affect Mill Values of Cottonseed

*The Relation of Percentages of Oil, Ammonia and Meats
in Whole Cottonseed to the Carbohydrate Content of Meats*

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THE oil and the protein in cottonseed are found in the kernels or meats. In the natural state the hulls or seed coats, contain no oil, and less than one-half of one per cent of ammonia, indicating less than 0.4 per cent of nitrogen, or 2.5 per cent of protein. The crushers of cottonseed therefore depend upon the meats for the production of oil and for the protein content of the cake.

The oil content of pure cottonseed meats varies from below 28 per cent to above 40 per cent; and the protein content varies from below 30 per cent to above 52 per cent. In combination the oil and protein together form from below 70 per cent to above 80 per cent of the meats. The residue, composed of carbohydrates, moisture and other minor materials, therefore forms from less than 20 per cent to more than 30 per cent of the meats. The differences in the content of these materials, in the meats of different lots of cottonseed, is therefore a factor of value in the seed.

The meats content of different lots of cottonseed varies from below 40 per cent to above 56 per cent of the whole seed, due to differences in the thickness and density of the hulls, but chiefly to differences in the vegetation development and density of the meats themselves.

Variations in the meats content of cottonseed present problems of separating meats from the hulls. The lower the percentage of meats the greater the difficulty of separation, both because of the lower specific gravity of the meats and also because of the larger portion of hulls, to be separated from the meats. Differences in the meats content of various lots of cottonseed is therefore a factor of value in the seed.

In the accompanying tables percentages of oil and ammonia in whole cottonseed are grouped in columns under various percentages of meats. In the left hand column are given the percentages of oil and protein in the meats, corresponding with and resulting from the combinations of the percentages of oil, ammonia

and meats in the whole seed. In Table I are grouped analyses of whole seed in which the combined oil and protein in the meats equal 70 per cent of the meats; in Table 2 the combined oil and protein equal 74 per cent of the meats; in Table 3 the combined oil and protein equal 76 per cent of the meats, and in Table 4 the combined oil and protein equal 80 per cent of the meats.

Similar tables may be prepared showing practically every possible combination of oil, ammonia and meats percentages found in whole seed and the corresponding oil and protein content of pure meats. These tables, however, are sufficient for this discussion. Tables 1 and 4 represent practically the extremes of variations, while Tables 2 and 3 represent the modal variations of normal cottonseed.

The average oil content of cottonseed, 19 per cent, and average ammonia content, 3.50 per cent, is found in the column 50 per cent meats, Table 2. In the left hand column it is seen that these percentages of oil, ammonia and meats in whole seed indicate that the percentage of oil in the meats is 38 and the percentage of protein 36, making a combination of 74 per cent of the meats.

These tables show that when the percentage of oil in whole cottonseed remains constant, increase in the ammonia content is the result of increases in the meats content and is coincident with increase in the content of materials in the meats other than protein and fat. Also that increases in both oil and ammonia in whole seed result from increases in the meats content and may or may not be coincident with increase of material in the meats other than protein and fat, depending upon the ratio of the increase in ammonia.

The tables also furnish a basis for visualizing the composition of cottonseed in connection with various growing conditions. For instance, typical combinations of oil and ammonia in seed produced in the drought area of Arkansas,

Mississippi and Tennessee, during the past season, are found in the columns of meat content between 40 and 45 per cent, Tables 3 and 4, indicating a retarded or arrested vegetative development of the kernels or meats.

Typical combinations of oil and ammonia, in seed produced in northwestern Texas and western Oklahoma, are to be found in the columns of percentages of meats above 50 and generally also in Table 1 in which the combined oil and protein is only 70 per cent of the meats and are therefore concurrent with a high con-

tent of non-protein or fat materials in the meats, chiefly carbohydrates.

These significant differences in the carbohydrate content of cottonseed meats doubtless have marked influence on the color and refining loss of oil and possibly also on the color of the cake. High carbohydrate content may indicate lower cooking temperatures.

Variations in the content of carbohydrates in cottonseed kernels has apparently received very little consideration in past studies of the composition of cottonseed.

TABLES SHOWING THE RELATION BETWEEN THE PERCENTAGES OF OIL, AMMONIA AND MEATS IN WHOLE SEED AND COMBINED OIL AND PROTEIN IN MEATS

Table 1
Percentages of meats in whole seed

Oil & Protein totaling 70% of meats		42		44		46		48		50		52		54		56	
Oil Per cent	Protein Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent
28	42	11.76	3.43	12.32	3.60	12.88	3.76	13.44	3.92	14.00	4.09	14.56	4.25	15.12	4.41	15.68	4.57
29	41	12.18	3.35	12.76	3.51	13.34	3.67	13.92	3.83	14.50	3.99	15.08	4.15	15.66	4.30	16.24	4.46
30	40	12.60	3.27	13.20	3.42	13.80	3.58	14.40	3.73	15.00	3.89	15.60	4.05	16.20	4.20	16.80	4.36
31	39	13.02	3.19	13.64	3.33	14.26	3.49	14.88	3.65	15.50	3.79	16.12	3.94	16.74	4.10	17.36	4.24
32	38	13.44	3.10	14.08	3.25	14.72	3.40	15.36	3.55	16.00	3.70	16.64	3.84	17.28	3.99	17.92	4.14
33	37	13.86	3.02	14.52	3.16	15.18	3.31	15.84	3.45	16.50	3.60	17.16	3.75	17.82	3.89	18.48	4.03
34	36	14.28	2.94	14.96	3.08	15.64	3.22	16.32	3.36	17.00	3.50	17.68	3.64	18.36	3.78	19.04	3.92
35	35	14.70	2.85	15.40	2.99	16.10	3.13	16.80	3.27	17.50	3.40	18.20	3.54	18.90	3.67	19.60	3.82
36	34	15.12	2.77	15.84	2.91	16.56	3.04	17.28	3.17	18.00	3.31	18.72	3.44	19.44	3.57	20.16	3.71
37	33	15.54	2.70	16.28	2.82	17.02	2.95	17.76	3.08	18.50	3.21	19.24	3.33	19.98	3.47	20.72	3.60
38	32	15.96	2.61	16.72	2.74	17.48	2.86	18.24	2.99	19.00	3.11	19.76	3.23	20.52	3.36	21.28	3.49
39	31	16.38	2.53	17.16	2.65	17.94	2.77	18.72	2.89	19.50	3.02	20.28	3.14	21.06	3.26	21.84	3.38
40	30	16.80	2.45	17.60	2.57	18.40	2.69	19.20	2.80	20.00	2.92	20.80	3.04	21.60	3.15	22.40	3.27

Table 2
Percentages of meats in whole seed

Oil & Protein totaling 74% of meats		42		44		46		48		50		52		54		56	
Oil Per cent	Protein Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent
28	46	11.76	3.76	12.32	3.94	12.88	4.11	13.44	4.29	14.00	4.47	14.56	4.66	15.12	4.83	15.68	5.01
29	45	12.18	3.67	12.76	3.85	13.34	4.02	13.92	4.20	14.50	4.38	15.08	4.55	15.66	4.73	16.24	4.90
30	44	12.60	3.60	13.20	3.77	13.80	3.94	14.40	4.11	15.00	4.28	15.60	4.45	16.20	4.62	16.80	4.79
31	43	13.02	3.51	13.64	3.68	14.26	3.84	14.88	4.01	15.50	4.18	16.12	4.35	16.74	4.51	17.36	4.68
32	42	13.44	3.43	14.08	3.60	14.72	3.76	15.36	3.92	16.00	4.09	16.64	4.25	17.28	4.41	17.92	4.57
33	41	13.86	3.35	14.52	3.51	15.18	3.67	15.84	3.83	16.50	3.99	17.16	4.15	17.82	4.30	18.48	4.46
34	40	14.28	3.27	14.96	3.42	15.64	3.58	16.32	3.73	17.00	3.89	17.68	4.05	18.36	4.20	19.04	4.36
35	39	14.70	3.19	15.40	3.33	16.10	3.49	16.80	3.64	17.50	3.79	18.20	3.94	18.90	4.10	19.60	4.24
36	38	15.12	3.10	15.84	3.24	16.56	3.40	17.28	3.55	18.00	3.70	18.72	3.84	19.44	3.99	20.16	4.14
37	37	15.54	3.03	16.28	3.16	17.02	3.31	17.76	3.45	18.50	3.60	19.24	3.75	19.98	3.89	20.72	4.03
38	36	15.96	2.94	16.72	3.08	17.48	3.22	18.24	3.36	19.00	3.50	19.76	3.65	20.78	3.65	21.28	3.92
39	35	16.38	2.86	17.16	2.99	17.94	3.14	18.72	3.27	19.50	3.40	20.28	3.54	21.06	3.67	21.84	3.82
40	34	16.80	2.77	17.60	2.91	18.40	3.04	19.20	3.17	20.00	3.17	20.80	3.44	21.60	3.57	22.40	3.71

Table 3
Percentages of meats in whole seed

Oil & Protein totaling 76% of meats		42		44		46		48		50		52		54		56	
Oil Per cent	Protein Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent
28	48	11.76	3.92	12.32	4.11	12.88	4.29	13.44	4.48	14.00	4.67	14.56	4.85	15.12	5.04	15.68	5.23
29	47	12.18	3.84	12.76	4.02	13.34	4.21	13.92	4.39	14.50	4.57	15.08	4.75	15.66	4.94	16.24	5.12
30	46	12.60	3.76	13.20	3.94	13.80	4.11	14.40	4.28	15.00	4.47	15.60	4.66	16.20	4.83	16.80	5.01
31	45	13.02	3.67	13.64	3.85	14.26	4.02	14.88	4.20	15.50	4.38	16.12	4.55	16.74	4.73	17.36	4.90
32	44	13.44	3.60	14.08	3.77	14.72	3.94	15.36	4.11	16.00	4.28	16.64	4.45	17.28	4.62	17.92	4.79
33	43	13.86	3.51	14.52	3.68	15.18	3.84	15.84	4.01	16.50	4.18	17.16	4.35	17.82	4.51	18.48	4.68
34	42	14.28	3.43	14.96	3.60	15.64	3.76	16.32	3.92	17.00	4.09	17.68	4.25	18.36	4.41	19.04	4.57
35	41	14.70	3.35	15.40	3.51	16.10	3.67	16.80	3.83	17.50	3.99	18.20	4.15	18.90	4.30	19.60	4.46
36	40	15.12	3.27	15.84	3.42	16.56	3.58	17.28	3.73	18.00	3.89	18.72	4.05	19.44	4.20	20.16	4.36
37	39	15.54	3.19	16.28	3.33	17.02	3.49	17.76	3.64	18.50	3.79	19.24	3.94	19.98	4.10	20.72	4.24
38	38	15.96	3.10	16.72	3.24	17.48	3.40	18.24	3.55	19.00	3.70	19.76	3.84	20.52	3.99	21.28	4.14
39	37	16.38	3.03	17.16	3.16	17.94	3.31	18.72	3.45	19.50	3.60	20.28	3.75	21.06	3.89	21.84	4.03
40	36	16.80	2.94	17.60	3.08	18.40	3.22	19.20	3.36	20.00	3.50	20.80	3.65	21.60	3.78	22.40	3.92

Table 4
Percentages of meats in whole seed

Oil & Protein totaling 80% of meats		42		44		46		48		50		52		54		56	
Oil Per cent	Protein Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent	Oil Per cent	NH ₃ Per cent
28	52	11.76	4.25	12.32	4.45	12.88	4.66	13.44	4.85	14.00	5.06	14.56	5.26	15.12	5.46	15.68	5.67
29	51	12.18	4.16	12.76	4.37	13.34	4.56	13.92	4.76	14.50	4.95	15.08	5.16	15.66	5.35	16.24	5.56
30	50	12.60	4.09	13.20	4.28	13.80	4.47	14.40	4.67	15.00	4.86	15.60	5.06	16.20	5.25	16.80	5.45
31	49	13.02	4.00	13.64	4.20	14.26	4.38	14.88	4.57	15.50	4.77	16.12	4.96	16.74	5.15	17.36	5.34
32	48	13.44	3.92	14.08	4.11	14.72	4.29	15.36	4.48	16.00	4.67	16.64	4.85	17.28	5.04	17.92	5.23
33	47	13.86	3.84	14.52	4.02	15.18	4.21	15.84	4.39	16.50	4.57	17.16	4.75	17.82	4.94	18.48	5.12
34	46	14.28	3.76	14.96	3.94	15.64	4.11	16.32	4.28	17.00	4.47	17.68	4.66	18.36	4.83	19.04	5.01
35	45	14.70	3.67	15.40	3.85	16.10	4.02	16.80	4.20	17.50	4.38	18.20	4.55	18.90	4.73	19.60	4.90
36	44	15.12	3.60	15.84	3.77	16.56	3.94	17.28	4.11	18.00	4.28	18.72	4.45	19.44	4.62	20.16	4.79
37	43	15.54	3.51	16.28	3.68	17.02	3.84	17.76	4.01	18.50	4.13	19.24	4.35	19.98	4.51	20.72	4.68
38	42	15.96	3.43	16.72	3.60	17.48	3.76	18.24	3.92	19.00	4.09	19.76	4.25	20.52	4.41	21.28	4.57
39	41	16.38	3.35	17.16	3.51	17.94	3.67	18.72	3.83	19.50	3.99	20.28	4.15	21.06	4.30	21.84	4.46
40	40	16.80	3.27	17.60	3.42	18.40	3.58	19.20	3.73	20.00	3.89	20.80	4.05	21.60	4.20	22.40	4.36