

TEXAS AGRICULTURAL EXPERIMENT STATION

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BULLETIN NO. 166.

MAY, 1914

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DIVISION OF CHEMISTRY

# Digestion Experiments With Texas Feeding Stuffs



POSTOFFICE  
College Station, Brazos County, Texas



VON BOECKMANN-JONES CO., PRINTERS, AUSTIN, TEXAS

1914

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## TABLE OF CONTENTS.

	PAGE
Definition of terms.....	5
Digestibility .....	6
Digestible nutrients in the feeds.....	7
Productive values of feeds.....	7
Method of conducting the experiments.....	10
Discussion of results.....	11
Alfalfa hay .....	12
Bermuda hay .....	12
Corn bran .....	12
Cold pressed cotton seed.....	12
Cotton seed hulls.....	13
Cotton seed meal.....	14
Kafir corn chops.....	16
Kafir head chops.....	16
Rice bran .....	16
Rice polish .....	16
Sorghum and cowpea silage.....	16
Sorghum hay .....	17
Prairie hay .....	17
Tabosa grass .....	17
Tables of composition and digestibility.....	18
References .....	20
Tables of calculations.....	21
Summary and conclusions.....	26

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# DIGESTION EXPERIMENTS WITH TEXAS FEEDING STUFFS

BY G. S. FRAPS, PH. D., Chemist.

This bulletin contains the results of digestion tests with the ordinary fodder groups of certain feeding stuffs. Other results have been published in Bulletin 149 of this Station. The work gives some information as to the relative values of some Texas feeding stuffs. More detailed studies conducted in connection with the work here reported will be presented in later bulletins.

## DEFINITION OF TERMS.

The ordinary analysis of a feeding stuff gives its content of water, ash, protein, ether extract, crude fiber and nitrogen-free extract, expressed in percentages. These terms are explained in the paragraphs which follow.

*Protein* is an important constituent of the food, which, when digested by the animal, is used largely to form flesh, muscle, hair, ligaments, and other similar portions of animal body. It is used for the purpose of replacing the material lost in the wear and tear caused by life activities, and it furnishes material for the formation of flesh, as in growing animals or in fattening animals. It may also be burned in the body to produce heat, or it may serve for the production of fat, but it is usually too expensive an ingredient of food to be used for this purpose to any extent. With a given feed, the more protein it contains, the better its quality compared with other feeds of the same kind. Protein is estimated by multiplying the nitrogen by 6.25.

*Ether extract* from concentrated feeding stuffs is composed mostly of fats and oils, but the ether extract from fodders and hays is composed to a considerable extent of wax alcohols, coloring matters, and other substances, as has been shown in Bulletin No. 150 of this Station.

Fat is used in the animal body as a source of body heat, and to furnish heat and energy. The animal requires heat to keep its body warm, more being, of course, required in cold weather than in warm weather. The animal requires energy to run the animal mechanism or to do outside work. This heat or energy is furnished by the burning of food in the body, and the process is analogous to the burning of coal or wood for the purpose of heating a house, or for making steam in a boiler to be used for the production of energy. One pound of digested fat is equal to 2.25 pounds of carbohydrates. Fat ranks next to protein in its value in a feeding stuff. The more protein and fat a feed contains, the better its quality as compared with other feeds of the same kind, but different feeds cannot be compared in this way.

*Crude fiber* is that part of the plant which is left after it has been subjected, first to action of boiling one and one-quarter per cent sulphuric acid and next to boiling one and one-quarter per cent sodium

hydroxide. Crude fiber consists mostly of the cell wall and woody material of the plant, and is the most indigestible part of the feed. Some animals, such as the hog, have little power of digesting crude fiber. Animals which chew the cud digest some crude fiber by means of fermentation in the intestines. The digestion is accomplished by means of bacteria which live in the digestive organs and not by the digestive juices. This process consumes so much energy that a large portion of the value of the crude fiber is lost during the digestion. The more crude fiber a feed contains, the poorer is its quality compared with other feeds of the same kind.

*Nitrogen-free extract* is a group containing a number of substances of widely differing properties. The nitrogen-free extract of concentrated feeding stuffs consists very largely of sugars and starches. These substances are easily digested, and have considerable value to the animal. The nitrogen-free extract of wheat skins, corn bran, corn cobs, rice hulls, hays, straws, and similar feeds, is composed mostly of other substances than sugar and starch, which are not so readily digested, and have a lower value to the animal after they have been digested, than the sugars and starches. The nitrogen-free extract of these two groups of feeds, therefore, cannot be compared directly. The nitrogen-free extract is composed, to a considerable extent, of carbohydrates. A carbohydrate contains hydrogen and oxygen in the proportion to form water, combined with carbon. The crude fiber of feeding stuffs also contains carbohydrates. Both the nitrogen-free extract and the crude fiber contain other substances in addition to the carbohydrates, so that it is not correct to designate these two groups as carbohydrates.

*Ash* is the residue left when the plant burns. With the exception of the nitrogen, the ash contains almost entirely that part of the plant which comes from the soil, though small portions of ash ingredients are driven off in the vapors during the combustion. The ash of plants is of value to animals. The lime, and also the phosphoric acid is used for building up bones. Phosphoric acid and sulphur are also essential constituents of animal cells. The ash constituents are necessary to animal life. Sometimes feeding stuffs do not contain sufficient ash, so that the ration gives rise to disease, or even death, on account of such deficiency. An excess of ash indicates contamination with dirt, sand, or other mineral matter.

*Water* is always contained in feeding stuffs, but this water has no value to the animal and detracts from the value of the feeding stuffs, by decreasing the total nutrients in 100 pounds. If the feed contains an excess of water, it is liable to be injured by mold, or by heating, or fermentation. In Bulletin No. 152 of this Station, it is shown that the heating of corn chops, which often occurs in Texas during the spring, is caused by an excess of water in the corn. The more water a feeding stuff contains, the less it contains of the nutrients, and the lower, therefore, in feeding value.

#### DIGESTIBILITY.

The digested part of a feed is that portion of the different constituents which disappears while the food is passing through the animal.

A portion of the food which disappears is converted into gases, and escapes in the form of carbon dioxide and marsh gas. All of the so-called digested nutrients do not pass through the animal membrane into the animal proper. The digested nutrients of one feed do not necessarily have the same value to the animal, pound for pound, as the digested nutrients of another feed. This fact has been fully established by experiments, although not generally recognized. For example, a pound of digested nitrogen-free extract from corn has a much greater value to the animal than a pound of digested nitrogen-free extract from alfalfa. This matter is discussed in a succeeding paragraph.

The digestibility of a feed, and its content of digestible nutrients, is, nevertheless, of considerable significance in judging the nutritive value of a feed. The feeding value can be calculated more or less accurately from the digested nutrients.

TABLE 1. Average Composition of Feeding Stuff and Composition of Those Used in the Experiments.

Laboratory No.		Protein.	Ether extract.	Crude fiber.	Nitrogen-free extract.	Water.	Ash.
	Alfalfa hay, average.....	14.66	1.93	28.42	35.81	9.12	8.39
6724-5	Alfalfa hay No. 1.....	14.45	1.58	28.45	39.24	7.60	8.68
7005-6	Alfalfa hay No. 2.....	14.95	1.43	30.57	38.81	6.00	8.24
	Bermuda hay, average.....	7.17	1.75	24.90	49.39	8.87	7.92
6027-8	Bermuda hay.....	5.54	1.44	26.54	49.75	8.27	8.46
	Corn bran, average (Texas).....	8.98	4.92	11.03	63.11	10.17	1.79
6907-8	Corn bran.....	9.25	5.44	10.31	64.63	8.16	2.21
	Cold pressed cotton seed, average.....	26.47	7.31	24.58	29.43	8.11	4.10
6747-8	Cold pressed cotton seed No. 1.....	25.58	9.90	23.51	29.97	6.82	4.22
7034-5	Cold pressed cotton seed No. 2.....	27.70	7.13	25.77	28.81	6.84	3.75
	Cottonseed meals, meal and hulls.....	29.18	7.38	23.67	27.96	7.27	4.54
	Cottonseed hulls, average.....	4.11	1.46	45.27	37.09	9.51	2.56
7048-9	Cottonseed hulls.....	3.97	0.82	49.76	34.71	8.25	2.49
	Cottonseed meal, Texas average.....	44.87	8.57	8.91	25.63	6.66	5.35
7050-1	Cottonseed meal, average of 174, July to Jan. 1913.....	44.20	11.29	8.13	23.93	6.68	5.77
	Kaffir corn chops, average.....	10.84	3.00	2.46	70.83	11.22	1.65
7009-10	Kaffir corn chops.....	11.05	2.42	2.42	70.53	12.01	1.57
	Kaffir head chops, average.....	10.03	2.67	7.07	67.24	9.82	3.17
7031-2	Kaffir head chops.....	9.57	2.36	8.00	67.42	9.56	3.09
6064-5	South Texas prairie hay, cut before frost.....	4.37	2.05	29.28	47.99	9.13	7.24
6123-4	South Texas prairie hay, cut after frost.....	3.70	2.15	30.20	46.36	8.73	8.86
	Rice bran, average.....	12.25	11.59	11.82	44.58	10.10	9.66
6770-1	Rice bran.....	12.45	13.48	10.56	45.92	7.98	9.61
	Rice polish, average.....	12.22	9.74	2.89	60.53	9.55	5.07
6879-80	Rice polish.....	12.77	10.43	4.46	57.76	7.96	6.62
	Sorghum silage, average.....	1.60	1.03	6.16	12.61	77.29	1.31
6998-9	Silage (sorghum and cowpea).....	2.23	0.71	8.54	18.25	68.42	1.87
	Sorghum fodder, average.....	5.38	2.80	28.52	48.77	8.86	5.67
6033-4	Sorghum hay.....	4.23	1.79	28.19	50.27	9.17	6.35
5912-13	Tabosa grass hay No. 1.....	3.70	1.15	33.38	45.60	6.84	9.33
6288-9	Tabosa grass hay No. 2.....	3.52	1.21	32.19	46.10	6.34	10.64

The *coefficient of digestibility* is the percentage of the particular nutrient which is digested. If the coefficient of digestibility of the protein in a given feed is given at 59.7, this means that of 100 pounds of the protein in the feed, 59.7 pounds disappear during the passage of the food through the animal. Digestibility of the Texas feeds tested, and the average coefficients of digestibility of these feeds, are given in Table No. 2. The averages are taken from the experiments made in different parts of this country, and detailed in Table No. 6. The Texas experiments are included in the averages given. Table No. 1 contains the composition of the feeds studied.

TABLE 2. Average Coefficients of Digestibility of Feeding Stuffs and Those Found in the Experiments.

Laboratory No.		Protein.	Ether extract.	Crude fiber.	Nitrogen-free extract.	Ash.
	Alfalfa hay, average.....	75.29	38.40	46.17	68.83	49.87
6724-5	Alfalfa hay No. 1 (4).....	77.10	20.31	42.46	72.59	52.01
7005-6	Alfalfa hay No. 2 (4).....	73.85	21.81	46.76	71.50	44.40
	Bermuda hay, average.....	53.10	41.60	53.17	50.63	33.73
6027-8	Bermuda hay (3).....	44.30	38.20	49.80	49.00	31.50
	Corn bran, average.....	58.20	76.63	59.56	77.21	8.48
6907-8	Corn bran (2).....	71.80	84.38	94.72	86.10	33.92
	Cold pressed cotton seed, average.....	74.28	85.98	39.55	63.23	54.22
6747-8	Cold pressed cotton seed No. 1 (2).....	81.73	96.97	50.28	73.68	66.65
7634-5	Cold pressed cotton seed No. 2 (2).....	80.21	94.39	45.67	70.88	41.78
	Cottonseed meal, rich in hulls.....	72.9	90.9	37.3	61.8	.....
	Cottonseed meal and hulls (2).....	77.69	97.29	51.04	67.91	26.22
	Cottonseed hulls, average.....	14.1	68.4	49.0	47.7	25.2
7048-9	Cottonseed hulls (2).....	61.42	61.82	61.77	63.25	84.73
	Cottonseed meal, average.....	85.93	94.84	15.22	71.88	18.69
7050-1	Cottonseed meal (2).....	85.14	98.84	11.90	71.94	54.67
	Kaffir corn chops, average.....	56.2	47.2	27.4	68.8	43.4
7009-10	Kaffir corn chops (2).....	81.22	75.58	52.06	92.13	48.59
7031-2	Kaffir head chops (2).....	63.41	74.35	61.08	80.41	36.15
6064-5	Prairie hay, cut before frost (3).....	8.6	39.1	53.5	46.9	4.9
6143-4	Prairie hay, cut after frost (3).....	9.0	57.3	66.7	57.1	28.0
	Rice bran, average.....	64.35	80.85	19.05	81.92	15.98
6770-1	Rice bran (2).....	67.83	88.95	33.73	79.37	28.53
	Rice polish, average.....	67.3	82.1	25.7	91.1	30.0
6879-80	Rice polish (2).....	69.03	90.60	29.39	89.58	28.65
	Sorghum silage, average.....	9.0	56.0	58.0	64.0	.....
6998-9	Silage (sorghum and cowpea) (2).....	23.77	57.93	49.24	63.67	19.82
	Sorghum fodder, average.....	35.5	62.2	60.6	61.5	.....
6033-4	Sorghum hay (3).....	13.9	54.0	55.6	55.9	23.4
5912-13	Tabosa grass hay No. 1 (2).....	17.0	27.2	52.5	41.8	18.4
6288-9	Tabosa grass hay No. 2 (2).....	22.9	46.7	56.5	53.1	21.4

## DIGESTIBLE NUTRIENTS IN THE FEED.

The average quantities of digestible nutrients in the various feeds, based on the coefficients of digestibility given in Table No. 2, and on the composition shown in Table No. 1, are presented in Table No. 3. The digestible nutrients contained in the feeds studied in this bulletin are also given in the table. This table contains the data for comparing the feeds, but a better method of comparison is given below.

TABLE 3. Digestible Constituents of Feeding Stuffs and Average Digestible Constituents.

Laboratory No.		Protein.	Ether extract.	Crude fiber.	Nitrogen-free extract.	Ash.
	Alfalfa hay, average.....	11.04	.32	13.01	24.65	4.18
6724-5	Alfalfa hay No. 1.....	11.14	.32	12.08	28.49	4.51
7005-6	Alfalfa hay No. 2.....	11.04	.31	14.29	27.75	3.66
	Bermuda hay, average.....	3.81	.73	13.24	25.01	2.67
6057-8	Bermuda hay.....	1.90	.55	13.22	24.38	2.66
	Corn bran, average.....	5.23	3.77	6.57	48.73	.15
6907-8	Corn bran.....	6.64	4.59	9.77	55.66	.75
	Cold pressed cotton seed, average.....	19.66	6.28	9.72	18.61	2.22
6747-8	Cold pressed cotton seed No. 1.....	20.91	9.60	11.82	22.10	2.81
7034-5	Cold pressed cotton seed No. 2.....	22.22	6.73	11.77	20.43	1.57
	Cottonseed meal and hulls.....	22.92	7.24	12.72	19.64	1.05
	Cottonseed hulls, average.....	.60	.90	22.18	17.69	2.17
7048-9	Cottonseed hulls.....	2.44	.51	30.74	21.96	2.11
	Cottonseed meal, average.....	38.55	8.13	1.35	18.42	1.00
7050-1	Cottonseed meal.....	37.63	11.16	.67	17.23	3.15
	Kaffir corn chops, average.....	6.09	1.42	.67	48.73	.72
7009-10	Kaffir corn chops.....	8.97	1.83	1.26	64.99	.76
	Kaffir head chops, average.....	6.36	1.98	4.32	54.07	1.15

TABLE 3. Digestible Constituents of Feeding Stuffs and Average Digestible Constituents—continued.

Laboratory No.		Protein.	Ether extract.	Crude fiber.	Nitrogen-free extract.	Ash.
7031-2	Kaffir head chops.....	6.07	1.75	4.88	54.23	1.12
6064-5	Prairie hay, cut before frost.....	.37	.80	15.66	22.49	.35
6143-4	Prairie hay, cut after frost.....	.33	1.23	20.14	26.57	2.48
	Rice bran, average.....	7.88	9.37	2.25	36.51	1.54
6770-1	Rice bran.....	8.44	11.99	3.56	36.46	2.74
	Rice polish, average.....	8.22	8.00	.74	55.14	1.52
6879-80	Rice polish.....	8.82	9.45	1.31	51.75	1.90
	Silage (sorghum), average.....	.14	.58	3.57	8.07	.....
6998-9	Silage (sorghum).....	.53	.41	4.20	11.62	.37
	Sorghum fodder, average.....	1.91	1.74	17.28	29.99	.....
6033-4	Sorghum hay.....	.59	.97	15.67	28.10	1.49
5912	Tabosa grass hay No. 1.....	.63	.31	17.52	19.06	1.72
6288-9	Tabosa grass hay No. 2.....	.81	.57	18.19	24.48	2.28

## PRODUCTIVE VALUE OF FEEDS.

The digestion of food requires a certain amount of work on the part of the animal. The amount of work varies with different feeds. A part of the work comes from the exertion of energy involved in chewing. This is decreased by grinding feeds, and experiments have shown that grinding or chopping the feed increases the actual production. A portion of the energy is lost in other ways in addition to the loss in chewing. Some of the differences in the values of different feeds is no doubt due to differences in chemical composition of the different groups of nutrients. The feeding stuffs which have lower productive values for their digestible nutrients do not contain the nitrogen-free extract in the same forms as those which have a high productive value.

The disposition of the productive value of a feeding stuff is as follows:

First, a portion is lost in chewing, and by other work of digestion. Second, a portion is lost by fermentation.

Third, a portion is eliminated in the undigested residues.

Fourth, a portion is lost as organic materials in the liquid excrement.

Fifth, a portion is probably lost in changing material into forms suitable for the purposes of the animal.

Sixth, the remainder of the food is available for the uses of the animal. It must first be used for the purpose of preserving the life of the animal, performing the bodily functions, such as the beating of the heart, movements of the lungs, etc., and keeping the animal warm. The feed must do all of this before any portion of it can be used for purposes that are useful to man.

Seventh, after all of the above uses are served, if there remains a portion of the value of the food, it may be used for productive purposes; that is to say, if the animal is a working animal, the remainder of the digested food may be used for the production of work. If the animal is a growing animal, it may be used for the production of flesh or fat. If the animal is giving milk, it may be used for the formation of milk. If the animal is fattening, it may be used for the production of fat, and of the small quantity of flesh which accompanies the fat formation.

But before the food may be used for work, or milk, or flesh, or fat, the bodily functions of the animal must be taken care of, and this and the losses involved in digestion take up a very large percentage of the food fed. The proportion taken up by the non-productive functions depends upon the size of the ration, up to the limit of the ability of the animal to digest and care for the food. The greater the ration, the greater is the portion which may be used for productive purposes. Thus, on a light fattening ration, an animal may use only one-tenth of the total food fed for productive purposes; but, on a heavy fattening ration, the animal may use as much as one-fourth. The quantity of food required to produce a given gain in weight will, therefore, depend to a considerable extent upon the size of the fattening ration. The same applies to other productive purposes, so that, in order to secure the most value from the food fed, it is necessary to feed a heavy ration. This matter will not be discussed in detail in the present bulletin.

The productive value of the different feeding stuffs is presented in Table No. 4. The calculations were made according to the method described in Fraps' Principles of Agricultural Chemistry, page 425. The factor used for corn bran is 0.77. Rice polish, cotton seed meal, rice bran and kafir corn, were given full values. Since the total crude fiber in kafir head chops, in cold pressed cotton seed, in cotton seed meal in excess of 5 per cent, and in rice bran in excess of 6 per cent comes from hay-like material, this crude fiber was multiplied by 0.14 and deducted. The total crude fiber in the hays and the cotton seed hulls was multiplied by 0.14 and deducted. The total crude fiber in sorghum silage, and sorghum and cowpea silage, was multiplied by 0.085 and deducted. These calculations place the silage on a parity with grass or green feeds.

These figures represent the productive values of these feeds according to our best present knowledge. Further advances may modify some of these conclusions.

The productive value of a feed is defined as the pounds of fat produced by 100 pounds of feed, when it is fed in addition to a ration sufficient to maintain the animal.

It is difficult to combine protein value and productive value into a single figure, as the value of protein is somewhat variable. We have made this combination in the table on the assumption that the flesh-forming value of protein is equal to its productive value. As the productive value of the protein has been considered in estimating the productive value of the entire feed, we simply add the fat value of the protein again to secure a figure assumed to represent the total productive value of the feed. Results are in Table No. 4.

#### METHOD OF CONDUCTING THE EXPERIMENTS.

The digestion experiments with the concentrates were carried out with several periods of twelve days each. In the first and last periods, the roughage was fed, consisting of alfalfa hay. In the other periods, the roughage and concentrates to be tested were fed, using 300 grams of hay to 300 grams of concentrates per day. The ration to be tested



was fed twelve days, and the excrement collected during the last six days. Enough hay was weighed out at the beginning of the experiment, in paper bags, to last during the entire experiment. Each feed was weighed out separately. Enough of the concentrate was weighed out at the beginning of the digestion period in which it is to be used, to last the entire period.

In the digestion experiment with silage, the preliminary period was six days, and the collecting period six days. The silage was brought to the laboratory daily, in the morning; mixed well in an iron tray, and four rations of 750 grams each weighed out for the two sheep; 500 grams were also weighed out and dried in the drying oven. At the end of the preliminary period, the samples taken during this period were combined, and constitute sample No. 1. The samples taken during the collecting period were combined and constitute sample No. 2. In other respects, this work was carried on as with the experiment on roughage.

TABLE 4. Digestible Crude Protein and Productive Value of Feed Studied, Pounds per Hundred Pounds Feed.

Laboratory No.		Protein, lbs.	Productive value.	Relative value.
	Alfalfa hay, average.....	11.04	8.18	10.77
6724-5	Alfalfa hay No. 1.....	11.14	8.93	11.55
7005-6	Alfalfa hay No. 2.....	11.04	8.97	11.56
	Bermuda hay, average.....	3.81	7.32	8.20
6057-8	Bermuda hay.....	1.90	6.39	7.28
	Corn bran, average.....	5.23	13.33	13.78
6907-8	Corn bran.....	6.64	15.91	17.47
	Cold pressed cotton seed, average.....	19.66	12.02	16.64
6747-8	Cold pressed cotton seed No. 1.....	20.21	15.68	20.43
7034-5	Cold pressed cotton seed No. 2.....	22.22	13.66	18.88
	Cottonseed hulls, average.....	.06	4.08	4.10
7048-9	Cottonseed hulls.....	.00	7.03	7.03
	Cottonseed meal, average 1913.....	38.55	18.31	27.37
7050-1	Cottonseed meal.....	37.63	19.63	28.47
	Cottonseed meal and hulls.....	22.92	14.49	19.88
	Kaffir corn chops, average.....	6.09	14.63	16.06
7009-10	Kaffir corn chops.....	8.97	19.77	21.88
	Kaffir head chops, average.....	6.36	16.30	17.79
7031-2	Kaffir head chops.....	6.07	16.13	17.56
6064-5	Prairie hay, cut before frost.....	.00	6.10	6.10
6143-4	Prairie hay, cut after frost.....	.08	8.11	8.19
	Rice bran, average.....	7.88	17.15	19.00
6770-1	Rice bran.....	8.44	19.16	21.14
	Rice polish, average.....	8.22	20.67	22.50
6879-80	Rice polish.....	8.82	20.99	23.06
	Sorghum silage, average.....	.14	2.69	2.72
6998-9	Silage (sorghum and cowpea).....	.53	3.55	3.67
	Sorghum fodder.....	1.91	9.19	9.64
6033-4	Sorghum hay.....	.59	7.59	7.73
5912	Tabosa grass hay No. 1.....	.63	4.77	4.92
6288-9	Tabosa grass hay No. 2.....	.81	6.57	6.76

The methods used for roughage are the same as those described in Bulletin No. 147 of this Station.

DESCRIPTION OF THE FEEDS AND DISCUSSION OF THE RESULTS.

The composition of the feeds used and the average composition of the feeds are shown in Table No. 1. Coefficients of digestibility are given in Table No. 2. The digestible nutrients are give in Table No. 3, and Table No. 4 shows the digestible crude protein and the pro-

ductive value as calculated from the best data available. A discussion of the individual feeding stuffs is given below.

#### ALFALFA HAY.

The digestibility of two samples of alfalfa hay was determined in connection with the estimation of the digestibility of the concentrates. The alfalfa hay was used merely as a medium with which to feed the concentrates. Four digestion experiments were made with each sample. The alfalfa hay seemed to be of fair quality, and, with the exception of ether extract, its digestibility was close as could be expected, to the average coefficients of digestibility.

#### BERMUDA HAY.

The Bermuda hay was purchased from a local dealer, and represents the hay as placed on the market. It contained a small quantity of foreign grasses, which were removed as much as possible. It is apparently below the average Bermuda hay in protein, but the writer is inclined to believe that the average is a little high for the market hay. The sample examined had a considerable lower digestibility for protein than the average of those previously reported. Bermuda hay is poor in digestible protein, but has a fairly high productive value as compared with some of the other hays.

#### CORN BRAN.

Corn bran is a product which is very variable in composition. This appears to depend upon the quantity of the germ which comes in with the bran, and also on the amount of the starchy material which goes along with the outer skin of the bran, which is the corn bran proper. The sample examined was a little above the average in protein and fat. Its digestibility was determined in connection with alfalfa hay. The protein of this particular corn bran was digested to a much greater extent than the protein in corn bran previously reported by other stations. The other constituents of the corn bran were also more highly digested, especially the crude fiber and the nitrogen-free extract. In view of these facts, it appears that it would be desirable to make further determinations of the digestibility of this product. The digestible protein and the productive value of the corn bran compares favorably with that of some of the other concentrated feeding stuffs. Corn bran in general seems to be a much richer feeding stuff than has been generally supposed and is by no means to be placed in the same class with peanut hulls and rice chaff.

#### COLD-PRESSED COTTON SEED

Cold-pressed cotton seed is a product obtained by compressing the entire seed of the cotton for the extraction of oil, after they have been cleaned and delinted. The word "cold-pressed" is not strictly true, since the seed become very hot while passing through the rolls.

Digestion experiments were made with two different samples of cold-pressed cotton seed, and also with a mixture of cotton seed meal and hulls. The object of the latter test was to ascertain whether the



cold-pressed cotton seed has a digestibility different from that of a mixture of meal and hulls of approximately the same protein content.

The samples of cold-pressed cake were near the average in composition, excepting that sample No. 1 contained considerably more fat than the average. Twelve German digestion experiments have been found in the literature. The crude fiber and the nitrogen-free extract of cotton seed hulls were digested to a much greater extent in this digestion experiment than, on an average, in the experiments previously reported. The digestibility of the mixture of cotton seed meal and hulls, corresponding to the cold-pressed feed, is very similar to the cold-pressed product. We have no reason to believe, therefore, that the cold-pressed product is any better digested than a mixture of meal and hulls of the same composition. The hulls in this mixture, however, were digested to a much greater extent than in previous experiments. The cold-pressed cotton seed, therefore, has a higher value than has heretofore been assigned to it.

The cold-pressed seed may be looked at from the point of view of a mixture of cottonseed meal and hulls. The relative proportions of cottonseed meal and hulls may be calculated from the percentage of protein present, with some degree of accuracy, but will depend upon the grade of meal for which the calculation is made.

If the calculations are based upon a protein content of 47.65 per cent in the meal (average Texas meal of 1907), the cold-pressed cotton seed would be composed of 48.6 per cent meal and 51.4 per cent hulls. The calculated composition of this mixture, compared with the average cold-pressed cotton seed, is as follows:

	48.6 meal and 51.4 hulls.	Cold-pressed cotton seed.
Protein.....	26.48	26.47
Ether extract .....	5.72	7.31
Crude fiber .....	25.33	24.58
Nitrogen-free extract .....	30.25	29.43
Water .....	8.02	8.11
Ash .....	4.20	4.10

The cold-pressed cotton seed, therefore, contains more ether extract (or fat) than would be present in a mixture of meal and hulls of the same protein content. According to statistics, 713 pounds meal and 975 pounds hulls are secured from a ton of seed. These figures are in the proportion of 42.2 per cent meal to 57.8 per cent hulls; if in this proportion, the meal must contain 57.5 per cent protein to give the protein content of the cold-pressed cotton seed.

#### COTTON SEED HULLS.

The cotton seed hulls were fed in connection with cotton seed meal and alfalfa hay, as mentioned above. The ether extract of the hulls used was lower than the average of previous analyses, but the analysis is probably nearer the composition of the hulls actually on the market now than the average analysis given. Cotton seed hulls now on the market contain less meats than was formerly the case, and also a

smaller quantity of absorbed oil, so that the average analysis usually given for ether extract is now too high.

The digestion experiments with the hulls give considerable higher results than the average coefficients of digestibility secured in experiments previously reported. (See Table No. 3.) The protein has a negative digestibility; that is, feeding the hulls decreased the digestibility of the protein of the other feeds with which it is fed. Similar results were secured by other workers. The average coefficients of digestibility of cotton seed hulls are increased by the experiments reported in this bulletin. It seems probable that cotton seed hulls contain much more digestible material than has been supposed from previous experiments, and, therefore, the hulls have a higher feeding value. The productive value of cotton seed hulls, calculated from the experiment reported in this bulletin, is nearly 75 per cent greater than the productive value calculated from the average co-efficients of digestibility, and the latter is also somewhat higher than has previously been calculated to be the case, since the digestion experiment here reported has been included in the average. Further studies of the digestibility of cotton seed hulls are desirable.

#### COTTON SEED MEAL.

Cotton seed meal consists of the residue left after the extraction of the oil from the kernels, together with such small quantities of hulls as are necessary to the proper extraction of the oil. The composition of cotton seed meal varies according to the composition of the kernel in the original seed, and according to the quantity of hulls which may be present in the meal. The estimation of the crude fiber affords a means of judging the quantity of hulls present. The kernels contain only a small quantity of crude fiber, while the hulls, as shown in the table of analyses, contain, on an average, about 45 per cent crude fiber. The quantity of crude fiber which is naturally present in the kernels cannot, at present, be definitely stated, but apparently should be less than 5 per cent. If we assume that the kernels should contain 5 per cent fiber after the oil is removed and that the hulls contain 45 per cent crude fiber, the calculation of the quantity of hulls present, according to a given fiber content, is a simple matter.

Let  $x$  be the quantity of hulls in the meal; then  $100-x$  is the quantity of meal from pure kernels in 100 pounds.

Let  $b$  equal the percentage of crude fiber.

Then  $x$  multiplied by  $.45 =$  the fiber from the hulls  $= .45x$ .

$(100-x)$  multiplied by  $.05$  is equal to the fiber from the pure meal; that is  $(100-x) .05 = 5 - .05x$ .

Then  $.45x + 5 - .05x =$  crude fiber in the mixture  $= b$ .

$x = \frac{b-5}{.4}$ . According to this calculation, to estimate approximately

.4

the quantity of cotton seed hulls in a cotton seed meal on a basis of 5 per cent for the kernel, subtract 5 from the quantity of crude fiber present in the meal and divide by 0.4. For example, suppose a cotton seed meal contains 9 per cent crude fiber;  $9-5=4$ .

$4 \div 0.4 = 10$ . Thus, a cottonseed meal with 9 per cent crude fiber

will contain approximately 10 pounds of cotton seed hulls and 90 pounds of meal from pure kernels. This estimation is only approximate, for two reasons: First, that the 5 per cent basis for the kernel is not exactly correct, but is much too high. Second, the hulls contained in the meal are not the same as the hulls containing the 45 per cent crude fiber, but really consists of hull bran. Hull bran is the woody part of the hulls, without the lint. Cotton seed hulls as removed from the seed carry some lint, which is high in crude fiber, while the hull proper contains a lower percentage. 'Since the hull bran contains less than 45 per cent crude fiber, calculations based on this percentage will be low.

Table A shows the average composition of samples of cotton seed meal collected by the Texas State Feed Inspectors between the dates given, and the percentages of hulls calculated to be present.

The effect of cotton seed hulls upon the nutritive value of cotton seed meal may be calculated in a very simple manner. If one pound of cotton seed meal, containing 0.4095 pounds digestible protein, is replaced by 1 pound cotton seed hulls, containing .006 pounds digestible protein, then the net loss is 0.4035 pounds digestible protein for each pounds of hulls added. If 1 pound of cotton seed meal having a productive value of 0.1948 is replaced by 1 pound cotton seed hulls, having a productive value of .0408, the result is a net loss of 0.154 pounds of productive value. It is known that the digestibility of cotton seed meal to which hulls have been added is less than that of the high-grade meal.

TABLE A. Average Composition of Texas Cottonseed Meal Samples Collected by Feed Inspectors.

	Protein.	Ether extract.	Crude fiber.	Nitrogen-free extract.	Water.	Ash.	No. samples.	Hulls, per cent.
July 1, 1907—Jan. 1, 1908.....	47.65	9.73	6.50	23.79	6.62	5.76	266	3.75
Jan. 1, 1908—July 1, 1908.....	44.88	8.94	6.91	23.91	6.86	5.61	158	4.77
July 1, 1908—Jan. 1, 1909.....	47.42	8.99	6.78	25.21	6.05	5.71	159	4.45
Jan. 1, 1909—July 1, 1909.....	44.86	9.09	7.65	26.31	6.24	5.81	98	6.62
July 1, 1909—Jan. 1, 1910.....	47.41	9.13	7.66	23.49	6.90	5.53	212	6.65
Jan. 1, 1910—July 1, 1910.....	45.75	8.91	7.85	24.97	7.09	5.25	74	7.10
July 1, 1910—Jan. 1, 1911.....	46.54	8.98	7.66	25.07	6.49	5.26	223	6.65
Jan. 1, 1911—July 1, 1911.....	45.55	8.87	8.11	25.10	6.97	5.28	112	7.78
July 1, 1911—Jan. 1, 1912.....	46.59	8.79	7.78	24.52	6.76	5.48	184	6.95
Jan. 1, 1912—July 1, 1912.....	45.21	8.33	8.79	24.72	7.42	7.42	163	9.48
July 1, 1912—Jan. 1, 1913.....	44.87	8.57	8.91	25.63	6.66	5.35	174	9.98
Jan. 1, 1913—July 1, 1913.....	44.79	8.37	9.22	25.07	7.15	5.34	189	10.55

The question has sometimes been asked us, what is the effect of the crude fiber upon the value of cotton seed meal. If protein, fat, water and ash remain constant, the increase in crude fiber means a decrease in nitrogen-free extract. Of 1 pound nitrogen-free extract in cotton seed meal, 0.719 pounds are digested; of 1 pound crude fiber, 0.152. The substitution of 1 pound crude fiber per hundred thus involves a loss of digestible nutriment equal to 0.567 pounds. This would have a productive value of 0.142 pounds. But for each per cent of crude fiber above 5, there is a loss of 0.14 pounds in productive value. The total loss is thus 0.282 in productive value. Since the productive value

of 100 pounds of cotton seed meal is about 18, the loss is about 1.6 per cent of the productive value for each per cent crude fiber. This calculation is perhaps a little high, since the crude fiber in cotton seed hulls are digested more than the factor used above for crude fiber in meal. If it be assumed that the crude fiber is digested to the same extent as in hulls (.49), the net loss would be  $\frac{.719-.49}{5}+14=.185$ , or about 1 per cent of the total productive value. On this basis, 1 per cent increase in crude fiber means 1 per cent loss in productive value. The true loss is probably between these two figures. The average would be a loss of 1.3 per cent of the productive value of each 1 per cent excess of crude fiber.

#### KAFIR CORN CHOPS.

Kafir corn chops consist of the grain of the kafir corn chopped up. The sample used is a little better than the average in protein and fat. The coefficients of digestibility are considerably higher than the average coefficients previously secured by other workers. Further studies of the digestibility of this product are desirable.

#### KAFIR HEAD CHOPS.

The kafir head chops consist of the entire grain of kafir corn, together with stalk or woody material of the head, chopped up together. The sample used is somewhat higher in crude fiber and a little lower in protein and fat than the average of a large number of analyses of kafir head chops made at this Experiment Station. We have found no record of any other digestion experiment with this material. The digestibility of the kafir head chops is considered above the average of the estimations of the digestibility of kafir head chops previously reported, although it is lower than the coefficient of digestibility for the kafir corn chops secured in our experiments.

#### RICE BRAN.

The sample of rice bran is somewhat better than the average in protein, and in crude fiber. The coefficients of digestibility secured are near the average, although somewhat better for fat. The sample examined has a higher productive value than the average, on account of the higher quantity of fat contained in it.

#### RICE POLISH.

The rice polish is near the average in protein and fat, but contains larger amounts of crude fiber than the average. The coefficients of digestibility are near the average with the exception of the fat, which is somewhat better than the average. The digestibility of the cotton seed meal in the experiments reported in this bulletin is very close to the average results previously reported by other workers, excepting that the ether extract is digested somewhat better.

## SORGHUM AND COWPEA SILAGE.

The silage consisted of sorghum silage with approximately 10 per cent cowpeas. It contained more protein and considerably less water than average sorghum silage. Sorghum silage seems to vary considerably in composition, especially in its content of nitrogen-free extract. With the exception of the protein, the coefficients of digestibility secured with the sorghum and cowpea silage are near those already reported for sorghum silage. The protein is digested to a much greater extent, although the digestibility is still very low. The result of this is, that the sorghum and cowpea silage contains a considerably higher percentage of digestible protein and a considerably higher productive value than average sorghum silage. The high productive value is due to some extent to the smaller quantity of water contained in this particular sample.

## SORGHUM HAY.

The sorghum hay had about the average composition. The coefficients of digestibility are lower than the average for sorghum fodder; especially is this true of the protein.

## PRAIRIE HAY.

The samples of prairie hay were sent by Mr. J. W. Carson, Superintendent of the Harris County Experiment Farm at Houston, and consists of hay of Harris county, cut before frost and cut after frost. The object of these experiments was to ascertain whether any appreciable difference shows between these two kinds of hay in their digestibility. The hay cut before frost was of good quality and free from dirt; the hay cut after frost contained a large quantity of weeds, which were removed as much as possible before the hay was prepared for the purpose of the digestion experiment. There was little difference in the composition, but the sample of hay cut after frost was more digestible than the other, and has a higher feeding value.

## TABOSA GRASS HAY.

Sample No. 1 came from Valentine, Jeff Davis county.

Sample No. 2 was examined by Professor Ness, Horticulturist of the Experiment Station; and identified as Tabosa grass or black bunch grass, *Hilaria Jamesii*, containing a very small amount of wire grass.

This is a different lot of hay from No. 1. The second sample was digested to a large extent, and has a higher feeding value than the first.

## ACKNOWLEDGMENT.

Analytical and other work involved in the preparation of this bulletin was taken part in by assistants, J. B. Rather, S. E. Asbury, L. C. Ludlum, J. C. Kelly, T. L. Ogier, William Levin, H. B. Spaulding, J. Cohen, and possibly others. Special mention should be made of the services of Mr. J. B. Rather.

TABLE 5. Composition of Feeds Compiled.

Laboratory No.		Protein.	Ether extract.	Crude fiber.	Nitrogen-free extract.	Water.	Ash.	Reference No.
	Alfalfa hay, average (34).....	14.42	1.97	29.98	35.81	9.61	8.41	1
	Alfalfa meal, average (52).....	14.81	1.90	27.54	38.48	8.80	8.38	2
	Average 86.....	14.66	1.93	28.42	37.35	9.12	8.39	
	Bermuda hay.....	8.75	2.19	21.65	48.81	10.00	8.60	3
	Bermuda hay.....	9.16	1.83	20.16	46.06	14.30	8.49	4
	Bermuda hay.....	8.75	2.90	21.64	48.46	10.36	8.60	4
	Bermuda hay.....	10.75	2.19	25.02	50.71	7.14	3.46	4
	Bermuda hay.....	6.43	1.60	27.62	46.70	9.74	7.88	1
	Bermuda hay.....	5.54	1.44	26.54	49.75	8.27	8.46	5
4334	Bermuda hay.....	6.34	1.44	26.82	49.63	7.14	8.63	15
4368	Bermuda hay.....	6.65	1.64	23.46	53.36	7.95	6.93	15
5723	Bermuda hay.....	5.75	1.36	27.44	50.83	6.56	8.06	15
6021	Bermuda hay.....	5.73	1.39	25.86	50.21	7.96	8.85	15
888	Bermuda hay.....	5.06	1.22	27.65	48.75	8.18	9.14	15
	Average (11).....	7.17	1.75	24.90	49.39	8.87	7.92	
	Corn bran, average (38).....	8.98	4.92	11.03	63.11	10.17	1.79	2
	Cold pressed cottonseed cake, average (73).....	26.47	7.31	24.58	29.53	8.11	4.10	2
	Cottonseed meal (265).....	47.90	9.40	8.18	24.55	6.93	5.48	16
	Cottonseed hulls.....	4.60	2.08	38.89	40.19	11.30	2.93	6
	Cottonseed hulls.....	3.76	1.54	42.83	41.75	7.25	2.88	7
	Cottonseed hulls, average of 7.....	4.87	2.07	38.00	44.11	8.03	2.92	8
	Cottonseed hulls, average of 24.....	4.36	2.22	43.28	36.88	10.53	2.73	8
	Cottonseed hulls, average of 4.....	4.04	2.02	44.42	36.52	10.41	2.59	8
	Cottonseed hulls.....	3.56	0.75	51.40	32.03	9.96	2.30	9
	Cottonseed hulls.....	4.37	2.20	42.01	39.28	9.28	2.86	10
	Cottonseed hulls.....	3.76	1.64	42.80	41.06	8.15	2.58	11
	Cottonseed hulls.....	4.18	2.01	46.61	32.91	11.80	2.59	12
	Cottonseed hulls.....	5.30	2.40	39.70	39.00	11.00	2.60	13
	Cottonseed hulls.....	4.22	2.74	43.48	35.56	12.35	1.65	14
867	Cottonseed hulls.....	4.70	0.94	48.91	33.60	8.52	3.33	15
3228	Cottonseed hulls.....	4.66	1.60	44.15	36.50	10.60	2.49	15
3665	Cottonseed hulls.....	4.56	1.80	46.76	35.22	9.21	2.45	15
4360	Cottonseed hulls.....	3.20	0.52	47.24	35.91	10.81	2.32	15
6016	Cottonseed hulls.....	3.28	0.73	46.22	37.21	10.23	2.33	15
6152	Cottonseed hulls.....	4.81	1.13	43.00	38.33	10.15	2.58	15
6153	Cottonseed hulls.....	4.50	1.68	45.65	37.49	8.24	2.44	15
6876	Cottonseed hulls.....	2.63	1.12	48.96	36.50	8.59	2.20	15
6947	Cottonseed hulls.....	3.35	0.77	47.68	37.48	8.30	2.42	15
6984	Cottonseed hulls.....	4.02	0.73	45.32	38.53	8.78	2.62	15
7048	Cottonseed hulls.....	3.93	0.85	50.49	33.99	8.28	2.46	15
7049	Cottonseed hulls.....	4.00	0.79	49.03	35.45	8.22	2.51	15
	Cottonseed hulls.....	3.97	0.82	49.76	34.72	8.25	2.49	5
	Average (24).....	4.11	1.46	45.27	37.09	9.51	2.56	
	Kaffir corn chops (156).....	10.84	3.00	2.46	70.88	11.22	1.65	2
	Kaffir head chops, average of 29.....	10.03	2.67	7.07	67.07	9.82	3.17	2
	Rice bran, average of 158.....	12.27	11.59	11.82	44.73	10.10	9.66	2
	Rice polish, average of 97.....	12.22	9.74	2.89	60.38	9.55	5.07	2
	Sorghum silage.....	2.21	1.08	6.47	15.87	72.91	1.46	17
	Sorghum silage, average of 3.....	1.05	1.26	5.97	9.04	81.09	0.99	18
	Sorghum silage, average of 3.....	1.35	0.99	6.67	16.54	72.57	1.37	18
	Sorghum silage.....	1.49	1.18	5.75	15.79	74.37	1.13	18
	Sorghum silage.....	1.99	0.89	7.07	9.40	79.30	1.35	19
	Sorghum silage.....	1.76	1.07	5.69	11.07	78.89	1.52	19
	Sorghum silage.....	1.34	0.78	5.48	9.09	81.94	1.37	20
	Average (7).....	1.60	1.03	6.16	12.40	77.29	1.31	
	Sorghum fodder.....	5.80	1.55	23.26	55.47	5.75	8.17	21
	Sorghum fodder.....	7.81	2.05	33.15	44.84	7.15	5.00	22
	Sorghum fodder.....	3.69	5.47	27.76	49.64	10.02	3.42	23
	Sorghum fodder.....	5.20	4.27	30.68	45.16	10.49	4.17	23
	Sorghum fodder.....	5.58	1.66	28.07	47.24	10.56	6.91	1
	This bulletin.....	4.23	1.79	28.19	50.27	9.17	6.35	5
	Average (6).....	5.38	2.80	28.52	48.77	8.86	5.67	
	Mixture, meal and hulls.....	29.18	7.38	23.67	27.96	7.27	4.54	

TABLE 6. Digestibility of Feeding Stuffs as Reported by various Experiment Stations.

	Protein.	Ether extract.	Crude fiber.	Nitrogen-free extract.	Ash.	Reference No.
Alfalfa hay, average of 16	75.27	40.57	46.37	68.43	50.08	1
Alfalfa hay No. 1, this bulletin	77.10	20.31	42.46	72.59	52.00	5
Alfalfa hay No. 2	73.85	21.81	46.76	71.50	44.40	5
Average (18)	75.29	38.40	46.17	68.83	49.87	
Bermuda hay, average of 2	57.50	43.30	54.86	51.45	34.84	1
Bermuda hay, this bulletin	44.3	38.2	49.8	49.0	31.5	5
Average (3)	53.10	41.60	53.17	50.63	33.73	
Corn bran	52.24	67.17	25.75	68.19		25
Corn bran	53.4	72.3	53.1	79.6		26
Corn bran	55.35	82.71	64.66	74.94		27
Corn bran, this bulletin	71.8	84.38	94.72	86.10	33.9	5
Average (4)	58.20	76.63	59.56	77.21	8.48	
Kaffir corn	43.6	44.8	45.7	40.8	63.9	29
Kaffir corn	40.2	38.8	35.2	38.0	65.7	29
Kaffir corn meal	53.3	46.1		75.9		29
Kaffir corn meal	54.8			80.3	18.3	30
Kaffir corn chops	63.9	78.1	31.6	85.4	63.9	31
Kaffir corn chops, this bulletin	81.2	75.6	52.0	92.1	48.6	5
Average (6)	56.2	47.2	27.4	68.8	43.4	
Cottonseed hulls	12.3	87.1	45.2	37.4	20.9	37
Cottonseed hulls	1.2	89.3	47.3	45.7	21.5	37
Cottonseed hulls	5.7	78.1	52.1	30.4	20.6	38
Cottonseed hulls			46.5	51.2	28.2	39
Cottonseed hulls		72.8	47.1	48.4	25.3	39
Cottonseed hulls	43.5	78.4	46.2	51.8	47.6	40
Cottonseed hulls	49.9	79.6	45.7	53.5	37.8	40
This bulletin		61.8	61.8	63.3		
Average (8)	14.1	68.4	49.0	47.7	25.2	
Cottonseed meal	85.48	92.01		55.06	3.01	14
Cottonseed meal	88.12	94.37	46.83	43.84	19.77	14
Cottonseed meal	96.12	91.55		71.02	37.98	14
Cottonseed meal	83.50	90.10	19.50	60.50	34.10	14
Cottonseed meal	83.30	100.00		95.9		41
Cottonseed meal	82.20	97.20		94.7		41
Cottonseed meal	83.60	94.64	43.5	82.1		41
This bulletin	85.14	98.84	11.90	71.94	54.67	5
Average (8)	85.93	94.84	15.22	71.88	18.69	
Cottonseed meal, rich in hulls	73.4	90.8	22.7	46.2		42
Cottonseed meal, rich in hulls	75.8	87.8	14.7	54.5		42
Cottonseed meal, rich in hulls	73.2	100.0	23.1	54.6		42
Cottonseed meal, rich in hulls	69.4	85.1	30.0	57.4		42
Cottonseed meal, rich in hulls	69.3	80.9	42.8	63.3		42
Cottonseed meal, rich in hulls	61.6	83.8	61.3	59.4		42
Cottonseed meal, rich in hulls	74.6	96.0	31.4	62.6		42
Cottonseed meal, rich in hulls	74.3	89.8	40.8	66.0		42
Cottonseed meal, rich in hulls	71.9	82.4	55.4	68.6		42
Cottonseed meal, rich in hulls	78.1	92.8	43.7	65.6		42
Cottonseed meal, rich in hulls	78.4	95.5	55.3	70.6		42
Cottonseed meal, rich in hulls	74.7	106.6	25.1	67.2		42
Cottonseed meal and hulls	77.7	97.3	51.0	67.9		5
Cold pressed cotton seed	81.7	97.0	50.3	73.7		5
Cold pressed cotton seed	80.2	94.0	45.7	70.9		5
Average	74.28	85.98	39.55	63.23		
Rice bran	64.7	54.8	13.3	78.1	33.0	32
Rice bran	62.9	88.6	29.2	78.2	2.4	33
Rice meal	62.0	91.0		92.0		34
Rice bran, this bulletin	67.8	89.0	33.7	79.4	28.5	
Average (4)	64.35	80.85	19.05	81.92	15.98	



TABLE 6. Digestibility of Feeding Stuffs as Reported by various Experiment Stations—continued.

	Protein.	Ether extract.	Crude fiber.	Nitro- gen-free extract.	Ash.	Refer- ence No.
Rice polish.....	65.6	73.5	22.1	92.7	31.4	35
Rice polish, this bulletin.....	69.0	90.6	29.4	89.6	28.6	
Average (2).....	67.3	82.1	25.7	91.1	30.0	
Sorghum silage.....	9.0	56.0	58.0	64.0	.....	36
Sorghum fodder, average of 3 lots.....	42.7	65.0	62.3	63.3	33.9	1
Sorghum hay.....	13.9	54.0	55.6	55.9	23.4	
Average (4).....	35.5	62.2	60.6	61.5	31.3	

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Nutrients Fed, Excreted and Digested in Grams Per Period.

	Protein.	Ether extract.	Crude fiber.	Nitro- gen-free extract.	Ash.
Period No. 19, feed Tabosa grass.					
Sheep No. 1, fed No. 5912-13—Total fed, 3200 gm ..	118.4	36.8	1068.2	1459.2	298.6
Residue 763 gm., No. 5972 ..	28.2	8.8	251.9	342.5	73.2
Eaten ..	90.2	28.0	816.3	1116.7	225.4
Excreted 1404 gm., No. 5970 ..	78.1	14.7	374.9	620.7	216.1
Digested ..	12.2	3.3	441.4	496.0	9.3
Percentage digested ..	13.5	11.8	54.1	44.4	41.3
Sheep No. 5, fed 3200 gm ..	118.4	36.8	1068.2	1459.2	298.6
Residue 5 gm., No. 5912-13 ..	0.2	0.1	1.7	2.2	0.5
Eaten ..	118.2	36.7	1066.5	1457.0	298.1
Excreted 1976 gm., No. 5971 ..	93.9	21.1	524.2	886.8	311.6
Digested ..	24.3	15.6	524.3	570.2	13.5
Percentage digested ..	20.5	42.5	50.9	39.1	4.5
Average percentage digested (sheep) ..	17.0	27.2	32.5	41.8	18.4
Period No. 20, feed Bermuda hay.					
Sheep No. 4, feed No. 6027-28—Total fed 4800 gm ..	265.9	69.1	1273.9	2388.0	406.1
Residue (added) 117 gm., No. 6029 ..	8.5	1.8	26.2	45.8	25.3
Eaten ..	274.4	70.9	1300.1	2433.8	431.4
Excreted 2751 gm., No. 6041 ..	160.9	47.0	698.5	1319.9	310.0
Digested ..	113.5	23.9	601.6	1113.9	121.4
Percentage digested ..	41.4	33.7	46.3	45.8	38.1
Sheep No. 5 fed 4800 gm ..	265.9	69.1	1273.9	2391.0	406.1
Residue 5 gm., No. 6027-28 ..	0.3	0.1	1.3	2.5	0.4
Eaten ..	265.6	69.0	1272.6	2388.5	405.7
Excreted 2443 gm., No. 6042 ..	138.3	38.4	612.9	1159.7	287.3
Digested ..	127.3	30.6	659.7	1228.8	118.4
Percentage digested ..	47.9	44.3	51.8	51.4	29.2
Sheep No. 6, fed 4800 gm ..	265.9	69.1	1273.9	2388.0	406.1
Residue (added) 8 gm., No. 6030 ..	0.5	0.1	2.2	3.3	1.5
Eaten ..	266.4	69.2	1276.1	2391.3	407.6
Excreted 2522 gm., No. 6043 ..	150.6	43.9	622.4	1202.5	296.6
Digested ..	115.8	25.3	653.7	1188.8	111.0
Percentage digested (sheep) ..	43.5	36.6	51.2	47.9	27.2
Average percentage digested (3) ..	44.3	38.2	49.8	49.0	31.5
Period No. 21, feed Sorghum Hay.					
Sheep No. 4, feed No. 6033-34, total fed 4800 gm ..	203.0	85.9	1353.1	2413.0	304.8
Residue 300 gm., No. 6049 ..	19.1	6.0	89.4	132.9	26.9
Eaten ..	183.9	79.9	1263.7	2280.1	277.9
Excreted 2286 gm., No. 6046 ..	165.5	32.2	663.4	996.2	210.3
Digested ..	18.4	47.7	600.3	1283.9	67.6
Percentage digested ..	10.0	59.7	47.5	56.3	24.3
Sheep No. 5, fed 4800 gm ..	203.0	85.9	1353.1	2413.0	304.8
Residue 47 gm., No. 6050 ..	1.5	0.8	13.7	24.4	2.7
Eaten ..	201.5	85.1	1339.4	2388.6	302.1
Excreted 2062 gm., No. 6047 ..	169.9	39.2	498.4	925.6	231.6
Digested ..	31.6	45.9	841.0	146.3	70.5
Percentage digested ..	15.7	53.9	62.8	61.2	23.3
Sheep No. 6, fed 4800 gm ..	203.0	85.9	1353.3	2413.0	304.8
Residue 589 gm., No. 6051 ..	13.3	10.3	199.5	284.9	29.4
Eaten ..	189.7	75.6	1153.6	2128.1	275.4
Excreted 1950 gm., No. 6048 ..	159.5	39.0	501.5	847.1	202.8
Digested ..	30.2	36.6	652.1	1281.0	62.6
Percentage digested ..	15.9	48.4	56.5	60.2	22.7
Average percentage digested ..	13.9	54.0	55.6	55.9	23.4

## Nutrients Fed, Excreted and Digested in Grams Per Period—continued.

	Protein.	Ether extract.	Crude fiber.	Nitro- gen-free extract.	Ash.
Period No. 22, feed prairie hay, cut before frost.					
Sheep No. 1, feed No. 6064-65, total fed 4000 gm. ....	174.8	82.0	1171.2	1918.4	289.6
Residue 978 gm., No. 6081. ....	45.6	20.0	285.9	468.1	71.5
Eaten. ....	129.2	62.0	885.3	1450.3	218.1
Excreted 1809 gm., No. 6078. ....	165.0	42.3	420.2	789.3	229.2
Digested. ....	- 35.8	19.7	465.1	661.0	11.1
Percentage digested. ....	- 27.7	31.8	52.5	45.6	5.1
Sheep No. 5, fed 4000 gm. ....	174.8	82.0	1171.2	1918.4	289.6
Residue 202 gm., No. 6082. ....	9.4	4.9	58.4	94.6	14.6
Eaten. ....	165.4	77.1	1112.8	1823.8	275.0
Excreted 2202 gm., No. 6079. ....	183.6	45.1	533.2	985.8	263.4
Digested. ....	- 18.2	32.0	589.6	838.0	11.6
Percentage digested. ....	- 11.0	41.5	52.9	45.9	4.2
Sheep No. 6, fed 4000 gm. ....	174.8	82.0	1171.2	1918.4	289.6
Residue 28 gm., No. 6083. ....	1.1	0.5	9.7	12.4	1.9
Eaten. ....	173.7	81.5	1161.5	1906.0	287.7
Excreted 2132 gm., No. 6080. ....	151.2	45.6	524.0	969.2	242.8
Digested. ....	22.5	35.9	637.5	936.8	44.9
Percentage digested. ....	12.9	44.0	54.9	49.2	15.6
Average percentage digested (3). ....	- 8.6	39.1	53.5	46.9	4.9
Period No. 23, feed prairie hay, cut after frost.					
Sheep No. 1, feed No. 6143-44, total fed 4000 gm. ....	148.0	86.0	1208.0	1854.4	354.4
Residue 1890 gm., No. 6148. ....	68.6	42.3	552.4	884.5	167.6
Eaten. ....	79.4	43.7	655.6	969.9	186.8
Excreted 684 gm., No. 6145. ....	66.1	17.0	137.4	295.6	109.9
Digested. ....	13.3	26.7	518.2	674.3	76.9
Percentage digested. ....	16.7	61.1	79.0	70.5	41.2
Sheep No. 5, fed 4000 gm. ....	148.0	86.0	1208.0	1854.4	354.4
Residue 138 gm., No. 6149. ....	5.1	1.9	48.3	56.7	9.5
Eaten. ....	142.9	84.1	1158.7	1797.7	344.9
Excreted 1914 gm., No. 6146. ....	141.3	40.0	427.8	872.2	272.2
Digested. ....	1.6	44.1	730.9	925.5	72.7
Percentage digested. ....	1.1	52.4	63.1	51.5	21.1
Sheep No. 6, fed 4000 gm. ....	148.0	86.0	1208.0	1854.4	354.4
Residue (added) 57 gm., No. 6150. ....	2.2	1.3	17.2	26.2	5.0
Eaten. ....	150.2	87.3	1225.2	1880.6	359.4
Excreted 2082 gm., No. 6147. ....	136.4	36.2	503.0	953.1	281.1
Digested. ....	13.8	51.1	722.2	927.5	78.3
Percentage digested (sheep). ....	9.2	58.5	58.9	49.3	21.8
Average percentage digested (3). ....	9.0	57.3	66.7	57.1	28.0
Period No. 24, feed Tabosa grass.					
Sheep No. 4, feed No. 6288-89, total fed 4000 gm. ....	140.8	48.4	1287.6	1844.0	425.6
Residue 20 gm., No. 6288-89. ....	0.7	0.2	6.4	9.2	2.1
Eaten. ....	139.1	48.2	1281.2	1834.8	423.5
Excreted 2049 gm., No. 6209. ....	107.6	28.1	575.8	882.3	333.8
Digested. ....	31.5	20.1	705.4	952.5	89.7
Percentage digested. ....	22.7	41.7	55.1	51.9	21.2
Sheep No. 5, fed 4000 gm. ....	140.8	48.4	1287.6	1844.0	425.6
Residue 0 gm. No. —. ....					
Eaten. ....	140.8	48.4	1287.6	1844.0	425.6
Excreted 1970 gm., No. 6291. ....	108.4	23.4	543.7	843.9	333.9
Digested. ....	32.4	25.0	743.9	1000.1	91.7
Percentage digested. ....	23.0	51.7	57.8	54.2	21.5
Average percentage digested (2). ....	22.9	46.7	56.5	53.1	21.4
Period No. 24a, feed, alfalfa.					
Sheep No. 1, fed 3000 gm., alfalfa No. 6724-25. ....	433.5	47.4	853.5	1177.5	260.4
Total eaten. ....	433.5	47.4	853.5	1177.5	260.4
Excreted 1147 gm., No. 6749. ....	96.1	39.1	499.9	354.6	117.1
Digested. ....	337.4	8.3	353.6	842.9	143.3
Percentage digested. ....	77.83	17.51	41.43	71.58	55.03
Sheep No. 2, fed 3000 gm., alfalfa No. 6724-25. ....	433.5	47.4	853.5	1177.5	260.4
Total eaten. ....	433.5	47.4	853.5	1177.5	260.4
Excreted 1149 gm., No. 6750. ....	94.8	35.8	510.6	328.5	117.4
Digested. ....	338.7	11.6	342.9	849.0	143.0
Percentage digested. ....	78.13	24.49	40.17	72.10	54.91
Average percentage digested from alfalfa. ....	77.98	20.99	40.80	71.84	54.97

Nutrients Fed, Excreted and Digested in Grams Per Period—continued.

	Protein.	Ether extract.	Crude fiber.	Nitrogen-free extract.	Ash.
Period No. 25, alfalfa and cold pressed cotton seed.					
Sheep No. 1, fed 1800 gm., alfalfa No. 6724-25.....	260.1	28.4	512.1	706.5	156.2
Sheep No. 1, fed 1800 gm., cold pressed cotton seed No. 6747-48.....	460.4	178.2	423.2	539.8	76.0
Total eaten.....	720.5	206.6	935.3	1246.3	232.2
Excreted 1262 gm., No. 6784.....	147.9	29.4	505.1	364.8	103.7
Digested.....	572.6	177.2	430.2	881.5	128.5
Digested from alfalfa (No. 1).....	200.5	5.8	217.4	512.8	81.3
Digested from cold pressed cotton seed.....	372.1	171.4	212.8	368.7	47.2
Percentage digested from cold pressed cotton seed.....	80.82	96.18	50.28	67.99	62.11
Sheep No. 2, fed 1800 gm., alfalfa No. 6724-25.....					
Sheep No. 2, fed 1800 gm., cold pressed cotton seed No. 6747-48.....	460.4	178.2	423.2	539.8	76.0
Total eaten.....	720.5	206.6	935.3	1246.3	232.2
Excreted 1176 gm., No. 6785.....	139.5	26.6	505.1	305.1	96.8
Digested.....	581.0	180.0	430.2	941.2	135.4
Digested from alfalfa (No. 1).....	200.5	5.8	217.4	512.8	81.3
Digested from cold pressed cotton seed.....	380.5	174.2	212.8	428.4	54.1
Percentage digested from cold pressed cotton seed.....	82.64	97.76	50.28	79.36	71.18
Average percentage digested from cold pressed cotton seed.....	81.73	96.97	50.28	73.68	66.65
Period No. 26, alfalfa and rice bran.					
Sheep No. 1, fed 1800 gm., alfalfa No. 6724-25.....	260.1	28.4	512.1	706.5	156.2
Sheep No. 1, fed 1800 gm., rice bran No. 6770-71.....	224.1	242.6	190.1	826.9	173.0
Total eaten.....	484.2	271.0	702.2	1533.4	329.2
Excreted 1242 gm., No. 6894.....	137.9	53.9	413.8	378.8	208.8
Digested.....	346.3	217.1	288.4	1154.6	120.4
Digested from alfalfa (No. 1).....	200.5	5.8	217.4	512.8	81.3
Digested from rice bran.....	145.8	211.3	71.0	671.8	39.1
Percentage digested from rice bran.....	65.06	87.10	37.35	81.24	22.60
Sheep No. 2, fed 1800 gm., alfalfa No. 6724-25.....					
Sheep No. 2, fed 1800 gm., rice bran No. 6770-71.....	224.1	242.6	190.1	826.9	173.0
Total eaten.....	484.2	271.0	702.2	1533.4	329.2
Excreted 1252 gm., No. 6895.....	125.5	44.9	427.6	379.7	188.3
Digested.....	358.7	226.1	274.6	1153.7	140.9
Digested from alfalfa (No. 1).....	205.5	5.8	217.4	512.8	81.3
Digested from rice bran.....	153.2	220.3	57.2	640.9	59.6
Percentage digested from rice bran.....	70.59	90.80	30.09	77.50	34.45
Average percentage digested from rice bran.....	67.83	88.95	33.73	79.37	28.53
Period No. 27, alfalfa and rice polish.					
Sheep No. 1, fed 1800 gm., alfalfa No. 6724-25.....	260.1	28.4	512.1	706.5	156.2
Sheep No. 1, fed 1800 gm., rice polish No. 6879-80.....	229.9	187.7	80.3	1039.9	119.2
Total eaten.....	490.0	216.1	592.4	1746.4	275.4
Excreted 1031 gm., No. 6925.....	132.2	43.2	330.8	302.8	157.7
Digested.....	357.8	172.9	261.6	1443.6	117.7
Digested from alfalfa (No. 1).....	260.5	5.8	217.4	512.8	81.3
Digested from rice polish.....	151.3	167.1	44.2	930.8	36.4
Percentage digested from rice polish.....	65.81	89.02	55.04	89.51	30.54
Sheep No. 2, fed 1800 gm., alfalfa No. 6724-25.....					
Sheep No. 2, fed 1800 gm., rice polish No. 6879-80.....	229.9	187.7	80.3	1039.9	119.2
Total eaten.....	490.0	216.1	592.4	1746.4	275.4
Excreted 1073 gm., No. 6926.....	123.4	37.3	372.0	301.4	163.2
Digested.....	357.8	178.8	220.4	1445.0	112.2
Digested from alfalfa (No. 1).....	200.5	5.8	217.4	512.8	81.3
Digested from rice polish.....	166.1	173.0	3.0	932.2	31.9
Percentage digested from rice polish.....	72.25	92.17	3.74	89.65	26.76
Average percentage digested from rice polish.....	69.03	90.60	29.39	89.58	28.65
Period No. 28, alfalfa and corn bran.					
Sheep No. 1, fed 1800 gm., alfalfa No. 6724-25.....	260.1	28.4	512.1	706.5	156.2
Sheep No. 1, fed 1800 gm., corn bran No. 6907-08.....	166.5	97.9	185.6	1163.5	39.8
Total eaten.....	426.6	126.3	697.7	1870.0	196.0
Excreted 980 gm., No. 6974.....	108.0	35.3	323.7	353.7	100.5
Digested.....	318.6	91.0	374.0	1516.3	95.5
Digested from alfalfa (No. 1).....	200.5	5.8	217.4	512.8	81.3
Digested from corn bran.....	118.1	85.2	156.6	1003.5	14.2
Percentage digested from corn bran.....	70.93	87.03	84.37	86.25	35.68

## Nutrients Fed, Excreted and Digested in Grams Per Period—continued.

	Protein.	Ether extract.	Crude fiber.	Nitro- gen-free extract.	Ash.
Sheep No. 2, fed 1800 gm., alfalfa No. 6724-25.....	260.1	28.4	512.1	706.5	156.2
Sheep No. 2, fed 1800 gm., corn bran No. 6907-08.....	166.5	97.9	185.6	1163.5	39.8
Total eaten.....	426.6	126.3	697.7	1870.0	196.0
Excreted 874 gm., No. 6975.....	105.1	40.5	285.3	282.1	101.9
Digested.....	321.5	85.8	412.4	1587.9	94.1
Digested from alfalfa (No.1).....	200.5	5.8	217.4	512.8	81.3
Digested from corn bran.....	121.0	80.0	195.0	1075.1	12.8
Percentage digested from corn bran.....	72.67	81.72	105.06	85.95	32.16
Average percentage digested from corn bran.....	71.80	84.38	94.72	86.10	33.92
Period No. 29, alfalfa.					
Sheep No. 1, fed 3000 gm., alfalfa No. 6724-25.....	433.5	47.4	853.5	1177.5	260.4
Total eaten.....	433.5	47.4	853.5	1177.5	260.4
Excreted 1208 gm., No. 6985.....	111.4	40.5	520.0	331.2	134.9
Digested.....	322.1	6.9	333.5	846.3	125.5
Percentage digested.....	74.30	14.56	39.07	71.87	48.19
Sheep No. 2, fed 3000 gm., alfalfa No. 6724-25.....	433.5	47.4	853.5	1177.5	260.4
Total eaten.....	433.5	47.4	853.5	1177.5	260.4
Excreted 1048 gm., No. 6986.....	94.8	35.7	434.0	296.7	130.5
Digested.....	338.7	11.7	419.5	880.8	129.9
Percentage digested.....	78.13	24.68	49.15	74.80	49.88
Average percentage digested (alfalfa).....	76.22	19.62	44.11	73.34	49.04
Average No. 1 for 4 sheep, experiment 24a and 29.....	77.10	20.31	42.46	72.59	52.01
Period No. 30, feed, silage.					
Sheep No. 1, feed No. 6998-99, total fed 9000 gm.....	200.7	63.9	768.6	1642.5	168.3
Eaten.....	200.7	63.9	768.6	1642.5	168.3
Excreted 1353 gm., No. 7000.....	148.0	25.6	379.7	572.5	124.2
Digested.....	52.7	38.3	388.9	1070.0	44.1
Percentage digested.....	26.26	59.94	50.60	65.14	26.20
Sheep No. 2, fed 9000 gm.....	200.7	63.9	768.6	1642.5	168.3
Residue (added) 27 gm., No. 6998-99.....	1.8	0.6	6.7	14.4	1.5
Eaten.....	198.9	63.3	761.9	1628.1	166.8
Excreted 1459 gm., No. 7001.....	156.6	27.9	397.1	615.7	144.4
Digested.....	42.3	35.4	364.8	1012.4	22.4
Percentage digested.....	21.27	55.92	47.88	62.19	13.43
Average percentage digested (2).....	23.77	57.93	49.24	63.67	19.82
Period No. 31, alfalfa.					
Sheep No. 3, fed 3000 gm., alfalfa No. 7005-06.....	448.5	42.9	917.1	1164.6	247.2
Total eaten.....	448.5	42.9	917.1	1164.6	247.2
Excreted 1142 gm., No. 7029.....	112.0	29.9	470.5	335.1	130.3
Digested.....	336.5	13.0	446.6	829.5	116.9
Percentage digested.....	75.03	30.30	48.70	71.23	47.29
Sheep No. 4, fed 3000 gm., alfalfa No. 7005-06.....	448.5	42.9	917.1	1164.6	247.2
Total eaten.....	448.5	42.9	917.1	1164.6	247.2
Excreted 1232 gm., No. 7023.....	119.3	34.5	518.4	341.4	144.7
Digested.....	329.2	8.4	398.7	823.2	102.5
Percentage digested.....	73.40	19.58	43.47	70.69	41.46
Average percentage digested (alfalfa 2).....	74.22	24.94	46.09	70.96	44.38
Period No. 32, alfalfa and Kaffir chops.					
Sheep No. 3, fed 1800 gm., alfalfa No. 7005-06.....	269.1	25.7	550.3	698.8	148.3
Sheep No. 3, fed 1800 gm., Kaffir chops No. 7009-10.....	198.9	43.6	43.6	1269.7	28.3
Total eaten.....	468.0	69.3	593.9	1968.5	176.6
Excreted 876 gm., No. 7029.....	116.4	32.1	314.2	255.0	93.4
Digested.....	351.6	37.2	279.7	1713.5	77.2
Digested from alfalfa.....	198.7	5.6	257.2	499.7	65.9
Digested from Kaffir chops.....	152.9	31.6	22.5	1213.8	11.3
Percentage digested from Kaffir chops.....	76.87	72.48	57.61	95.60	39.93
Sheep No. 4, fed 1800 gm., alfalfa No. 7005-06.....	269.1	25.7	550.3	698.8	148.3
Sheep No. 4, fed 1800 gm., Kaffir chops No. 7009-10.....	198.9	43.6	43.6	1269.7	28.3
Total eaten.....	468.0	69.3	593.9	1968.5	176.6
Excreted 941 gm., No. 7030.....	99.1	29.4	313.8	343.1	94.5
Digested.....	368.9	39.9	280.1	1625.4	82.1
Digested from alfalfa.....	198.7	5.6	257.2	499.7	65.9
Digested from Kaffir chops.....	170.2	34.3	22.9	1125.7	16.2
Percentage digested from Kaffir chops.....	85.57	78.67	52.52	88.66	57.24
Average percentage digested Kaffir chops.....	81.22	75.58	52.06	92.13	48.59

Nutrients Fed, Excreted and Digested in Grams Per Period—continued.

	Protein.	Ether extract.	Crude fiber.	Nitrogen-free extract.	Ash.
Period No. 23, alfalfa and Kaffir heads.					
Sheep No. 3, fed 1800 gm., alfalfa No. 7005-06.	269.1	25.7	550.3	698.8	148.3
Sheep No. 3, fed 1800 gm., Kaffir heads No. 7031-32.	172.3	42.5	144.0	1213.9	55.6
Uneaten 6 gm., heads No. 7031-32.	0.6	0.1	0.5	4.0	0.2
Total eaten.	440.8	68.1	693.8	1908.7	203.7
Excreted 995 gm., No. 7046.	122.4	25.6	332.9	332.2	112.2
Digested.	318.4	42.5	360.9	1576.5	91.5
Digested from alfalfa.	198.7	5.6	257.2	499.7	65.9
Digested from Kaffir heads.	119.7	36.9	103.7	1076.8	25.6
Percentage digested from Kaffir heads.	69.47	86.82	72.01	88.71	46.04
Period No. 23, alfalfa and Kaffir heads.					
Sheep No. 4, fed 1800 gm., alfalfa No. 7005-06.	269.1	25.7	550.3	698.8	148.3
Sheep No. 4, fed 1800 gm., Kaffir heads No. 7031-32.	172.3	42.5	144.0	1213.9	55.6
Uneaten 3 gm., heads No. 7031-32.	0.3	0.1	0.2	2.0	1.0
Total eaten.	441.1	68.1	694.1	1910.7	203.8
Excreted 1303 gm., No. 7047.	143.6	36.2	364.7	535.7	123.3
Digested.	297.5	31.9	329.4	1375.0	80.5
Digested from alfalfa.	198.7	5.6	257.2	499.7	65.9
Digested from Kaffir heads.	98.8	26.3	72.2	875.3	14.6
Percentage digested from Kaffir heads.	57.34	61.88	50.14	72.11	26.26
Average percentage digested from Kaffir heads.	63.41	74.35	61.08	80.41	36.15
Period No. 34, alfalfa and cold pressed cottonseed.					
Sheep No. 3, fed 1800 gm., alfalfa No. 7005-06.	269.1	25.7	550.3	698.8	148.3
Sheep No. 3, fed 1800 gm., cold pressed cottonseed No. 7034-35.	498.6	128.3	463.9	518.8	67.5
Total eaten.	767.7	154.0	1014.2	1217.6	215.8
Excreted 1289 gm., No. 7052.	161.1	26.4	551.4	343.9	107.6
Digested.	606.6	127.6	462.8	873.7	108.2
Digested from alfalfa.	198.7	5.6	257.2	499.7	65.9
Digested from cold pressed cottonseed.	407.9	122.0	205.6	374.0	42.3
Percentage digested from cold pressed cottonseed.	81.81	95.09	44.32	72.09	62.67
Period No. 34, alfalfa and cold pressed cottonseed.					
Sheep No. 4, fed 1800 gm., alfalfa No. 7005-06.	269.1	25.7	550.3	698.8	148.3
Sheep No. 4, fed 1800 gm., cold pressed cottonseed No. 7034-35.	498.6	128.3	463.9	518.8	67.5
Total eaten.	767.7	154.0	1014.2	1217.6	215.8
Excreted 1354 gm., 7053.	177.1	28.2	538.9	377.2	135.8
Digested.	590.6	125.8	475.3	840.4	80.0
Digested from alfalfa.	198.7	5.6	257.2	499.7	65.9
Digested from cold pressed cottonseed.	391.9	120.2	218.1	340.7	14.1
Percentage digested from cold pressed cottonseed.	78.60	93.69	47.01	69.67	20.89
Average percentage digested from cold pressed cottonseed.	80.21	94.39	45.67	70.88	41.78
Period No. 35.					
Sheep No. 3, fed 1800 gm., alfalfa No. 7005-06.	269.1	25.7	550.3	698.8	148.3
Sheep No. 3, fed 672 gm., cottonseed hulls No. 7048-49.	26.7	5.5	334.4	233.3	16.7
Sheep No. 3, fed 1128 gm., cottonseed meal No. 7050-51.	498.6	127.4	91.7	270.1	65.1
Total eaten.	794.4	158.6	976.4	1202.0	230.1
Excreted 1278 gm., No. 7076.	183.0	22.7	490.3	349.0	145.2
Digested.	611.4	135.9	486.1	853.2	84.9
Digested from alfalfa.	198.7	5.6	257.2	499.7	65.9
Digested from meal and hulls.	412.7	130.3	228.9	353.5	19.0
Digested from cottonseed meal.	424.5	125.9	10.9	194.3	35.6
Digested from cottonseed hulls.	- 11.8	4.4	218.0	139.2	- 16.6
Percentage digested from meal and hulls.	78.57	98.04	53.72	70.22	23.22
Percentage digested from cottonseed hulls.	- 44.19	80.00	65.19	68.24	- 99.44
Period No. 35.					
Sheep No. 4, fed 1800 gm., alfalfa No. 7005-06.	269.1	25.7	550.3	698.8	148.3
Sheep No. 4, fed 672 gm., cottonseed hulls No. 7048-49.	26.7	5.5	334.4	233.3	16.7
Sheep No. 4, fed 1128 gm., cottonseed meal No. 7050-51.	498.6	127.4	91.7	270.1	65.1
Total eaten.	794.4	158.6	976.4	1202.0	230.1
Excreted 1330 gm., No. 7077.	192.2	24.7	513.2	372.1	140.3
Digested.	602.2	133.9	463.2	829.9	89.8
Digested from alfalfa.	198.7	5.6	257.2	499.7	65.9
Digested from meal and hulls.	403.5	128.3	206.0	330.2	23.9
Digested from cottonseed meal.	424.5	125.9	10.9	194.3	35.6
Digested from cottonseed hulls.	- 21.0	2.4	195.1	135.9	- 11.7
Percentage digested from meal and hulls.	76.81	96.54	48.35	65.59	29.22
Percentage digested from cottonseed hulls.	- 78.65	43.64	58.34	58.25	- 70.06
Average percentage digested meal and hulls.	77.69	97.29	51.04	67.91	26.22
Average percentage digested cottonseed hulls.	- 61.42	61.82	61.77	63.25	- 84.37

## Nutrients Fed, Excreted and Digested in Grams Per Period—continued.

	Protein.	Ether extract.	Crude fiber.	Nitro- gen-free extract.	Ash.
Period No. 36, alfalfa and cottonseed meal.					
Sheep No. 3, fed 1800 gm., alfalfa No. 7005-06.....	269.1	25.7	550.3	698.8	148.3
Sheep No. 3, fed 1800 gm., cottonseed meal No. 7050-51.....	795.6	203.2	146.3	431.1	103.9
Total eaten.....	1064.7	228.9	696.6	1129.9	252.2
Excreted 1144 gm., No. 7100.....	183.7	21.9	426.5	308.5	126.1
Digested.....	881.0	207.0	270.1	821.4	126.1
Digested from alfalfa.....	198.7	5.6	257.2	499.7	65.9
Digested from cottonseed meal.....	682.3	201.4	12.9	321.7	60.2
Percentage digested from cottonseed meal.....	85.76	99.11	8.82	74.62	57.94
Sheep No. 4, fed 1800 gm., alfalfa No. 7005-06.....	269.1	25.7	550.3	698.8	148.3
Sheep No. 4, fed 1800 gm., cottonseed meal No. 7050-51.....	795.6	203.2	146.3	431.1	103.9
Total eaten.....	1064.7	228.9	696.6	1129.9	252.2
Excreted 1180 gm., No. 7101.....	193.6	23.0	417.5	331.6	132.9
Digested.....	871.1	205.9	279.1	798.3	119.3
Digested from alfalfa.....	198.7	5.6	257.2	499.7	65.9
Digested from cottonseed meal.....	672.4	200.3	21.9	298.6	53.4
Percentage digested from cottonseed meal.....	84.51	98.57	14.97	69.26	51.40
Average percentage digested from cottonseed meal.....	85.14	98.84	11.90	71.94	54.67
Period No. 37 alfalfa.					
Sheep No. 3, fed 3000 gm., alfalfa No. 7005-05.....	448.5	42.9	917.1	1164.6	247.2
Residue 7 gm., No. 7005-06.....	1.0	0.1	2.1	2.7	0.6
Total eaten.....	447.5	42.8	915.0	1161.9	246.6
Excreted 1202 gm., No. 7123.....	117.6	36.2	505.4	342.1	129.4
Digested.....	329.9	6.6	409.6	819.8	117.2
Percentage digested.....	73.72	15.42	44.76	70.56	47.53
Sheep No. 4, fed 3000 gm., alfalfa No. 7005-05.....	448.5	42.9	917.1	1164.6	247.2
Residue 7 gm., No. 7005-06.....	1.0	0.1	2.1	2.7	0.6
Total eaten.....	447.5	42.8	915.0	1161.9	246.6
Excreted 1132 gm., No. 7124.....	119.8	33.4	456.8	307.6	144.8
Digested.....	327.7	9.4	458.2	854.3	101.8
Percentage digested.....	73.23	21.96	50.08	73.52	41.28
Average percentage digested from alfalfa (2).....	73.48	18.69	47.42	72.04	44.41
Average percentage digested from alfalfa (4).....	73.85	21.81	46.76	71.50	44.40

## SUMMARY AND CONCLUSIONS.

This bulletin contains information concerning the digestibility and productive value of alfalfa hay, Bermuda hay, corn bran, cold-pressed cotton seed, cotton seed hulls, cotton seed meal, kafir corn chops, kafir head chops, rice bran, rice polish, sorghum and cowpea silage, sorghum hay, prairie hay, Tabosa grass.

The relative values of the feeding stuffs, the digestibility and the composition are shown in appropriate tables.