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THE COMPOSITION AND DIGESTIBILITY OF SUDAN GRASS HAY, DARSO, DARSO SILAGE, BROOM CORN SEED AND SUNFLOWER SILAGE

BY C. T. DOWELL AND W. G. FRIEDEMANN

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INTRODUCTION

The first three of these feed stuffs are being used very commonly in this and other states. Analyses have been made of all of them from time to time, but no digestion experiments have been made. The only digestion experiments that have been done are those by Gaessler and McCandlish (Research Bulletin 46, Iowa Experiment Station), who determined the digestibility of Sudan grass hay, using steers, and the digestion trial made on this substance at the Maryland Experiment Station. No digestion experiments have been carried out using darso or darso silage, and since this is a new variety of grain sorghum, it was thought worth while to determine its digestibility.

This state produces more broom corn than any other state in the Union, and on account of that fact there is an immense amount of broom corn seed produced, a great part of which, especially the partially ripe seed, we are told, is allowed to go to waste. This department made some analyses of broom corn seed about two years ago which indicated that the substance was a good feedstuff. The digestion trials which are reported in this bulletin indicate also that it is a good feedstuff, but before any conclusions can be drawn it will be necessary to do feeding experiments with it. Some of the farmers in this neighborhood tell us that horses and cattle eat broom corn seed and seem to do well upon them.

The Department of Animal Husbandry of this College is carrying on a feeding experiment to determine the value of sunflower silage, and since no digestion trial has been made with this substance, we decided to add this to our other trials for this year. Some work has already been done in the way of making this silage and studying its feeding value in Montana and Nevada. The results obtained in Nevada are reported in Bulletin 91 of that Station. The following quotation is taken from page 6 of that bulletin: "Later it was fed in connection with alfalfa hay and rolled barley to the University dairy herd with excellent results." The results of the trial with dairy cows at the Montana Station (Montana Experiment Station Bulletin 118) seemed to show that sunflower silage was equivalent to corn silage for the production of milk. It is stated on the last page of

this bulletin that digestion trials were conducted, but we have failed to find that they have been reported. The results of feeding sunflower silage to dairy cows is reported by George La Grange in the Jersey Bulletin and Dairy World 1917, p. 1749. It is stated that sunflower silage caused a greater flow of milk than corn silage and this was attributed to the supposed greater protein content of this silage. However, the results reported by Neidig and Vance in the Journal of Agricultural Research, Vol. 28, p. 325, show that sunflower silage contains only .3 per cent more protein than corn silage, while the nitrogen free extract of corn silage is 15.4 compared with 9.8 for sunflower silage. Otherwise the composition of the two silages is very nearly the same.

EXPERIMENTAL PART

All of the digestion experiments here reported were carried out with sheep. Since the crates used for the sheep are a little different from those described elsewhere, a description of them will be given.

The dimensions of the inside part are 20x40x35 inches. The back end of the crate was in the form of a door and the top was also hinged so that it could be swung back, and the crates stood about 9 inches off of the floor. They were provided with a removable bottom which had two circular grooves at the back end. Four or five holes were bored through each of these grooves so that the urine would drain through and not come in contact with the bags when the sheep were lying down. The crates were provided with another bottom of galvanized iron, and since the legs of the back part of the crate were cut about 1½ inches shorter than the others, this allowed the urine which came on to the galvanized bottom to drain back into pans which were used for its collection. The mangers were hooked on to the crates by means of U-shaped iron plates and were high enough in the front so that it was not possible for the sheep to throw the feed out by raising its head. These crates have been found very satisfactory, as it was possible to keep them clean, to remove the bag easily and to remove the refuse by simply taking off the manger. Water was kept before the sheep all the time in shallow buckets which were set in the manger.

All concentrated feeds were ground and the Sudan grass hay was cut in a fodder mill so that it could be mixed thoroughly before being fed.

The total feeding periods were about 12 days. There was a preliminary period of 7 days and the faeces were collected during the last 5 days. The faeces were collected twice a day, weighed and one-tenth was preserved in rubber sealed jars, using a few drops of formaldehyde for preservation. At the end of the collection period the faeces were dried at 70 degrees C.

The compositions of the feedstuff used in these digestion trials are shown in Table No. 1.

Feedstuff	Water	Ash	Protein	Fibre	N. Free Extract	Fat
Sudan grass hay	7.92	6.23	8.45	32.45	43.66	1.29
Darso	11.72	1.93	11.76	3.82	67.47	3.30
Broom corn seed.....	10.06	4.27	13.37	9.04	59.62	3.64
Sunflower silage.....	71.96	3.23	2.96	8.67	12.36	.81
Darso silage	73.11	1.54	1.91	6.46	16.65	.34

The quantity of Sudan grass hay feed, the amount of refuse and digestion co-efficients are shown in Table No. 2.

Sudan Grass Hay

Sheep No. 1	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
5000 grams Sudan grass hay fed...	4604.00	311.50	422.50	1622.50	2183.00	64.50
1500 grams Sudan grass hay not eaten	1389.45	95.85	112.05	504.30	660.60	16.65
Amount consumed	3214.55	215.65	310.45	1118.20	1522.40	47.85
1514 grams manure excreted (air dried)	1439.51	172.29	178.95	457.38	609.23	21.65
Grams digested	1775.04	43.36	131.50	660.82	913.17	26.20
Per cent digested.....	55.22	20.11	42.36	59.10	59.98	54.75

Sheep No. 2	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
5000 grams Sudan grass hay fed...	4604.00	311.50	422.50	1622.50	2183.00	64.50
1360 grams Sudan grass hay not eaten	1235.83	82.82	84.46	472.19	579.90	16.46
Amount consumed	3368.17	228.68	338.04	1150.31	1603.10	48.04
1484 grams manure excreted (air dried)	1413.81	174.37	170.66	445.20	602.95	20.63
Grams digested	1954.36	54.31	167.38	705.11	1000.15	27.41
Per cent digested.....	58.02	23.75	49.51	61.30	62.39	57.06

Sheep No. 3	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
5000 grams Sudan grass hay fed...	4604.00	311.50	422.50	1622.50	2183.00	64.50
1520 grams Sudan grass hay not eaten	1392.02	93.18	96.37	554.80	629.89	17.78
Amount consumed	3211.98	218.32	326.13	1067.70	1553.11	46.72
1530 grams manure excreted (air dried)	1447.84	169.37	167.23	470.78	621.49	18.97
Grams digested	1764.14	48.95	158.90	596.92	931.62	27.75
Per cent digested.....	54.92	22.42	48.72	55.91	59.98	59.40

Average digestibility of Sudan grass hay (excluding protein digestibility of Sheep No. 1): Ash, 22.09 per cent; protein, 49.12 per cent; fiber, 58.77 per cent; nitrogen free extract, 60.78 per cent; fat, 57.07 per cent; dry matter, 56.05 per cent.

The amount of darso consumed and the digestion co-efficients are shown in Table No. 3.

Darso

Sheep No. 1	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
5000 grams Sudan grass hay fed...	4583.00	399.00	552.50	1436.00	2123.00	72.50
2695 frams Sudan grass hay not eaten	2482.36	190.00	229.61	833.83	1174.21	54.71
Amount Sudan grass hay consumed	2100.64	209.00	322.89	602.17	948.79	17.79
2000 grams of darso fed.....	1765.60	38.60	235.20	76.40	1349.40	66.00
Amount consumed	3866.24	247.60	558.09	678.57	2298.19	83.79
1565 grams manure excreted (air dried)	1448.41	158.69	272.00	396.41	590.00	31.30
Grams digested	2417.83	88.91	286.09	282.16	1708.19	52.49
Minus Sudan grass hay digested...	1176.36	45.98	158.22	355.28	578.76	10.14
Darso digested	1241.47	42.93	127.87	———	1129.43	42.35
Per cent digested.....	70.31	———	54.37	———	83.70	64.17

—— minus quantity.

Sheep No. 2	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
5000 grams Sudan grass hay fed...	4583.00	399.00	522.50	1436.00	2123.00	72.50
2567.5 gms.Sudan grass hay not eaten	2341.30	184.09	225.43	790.79	1987.34	53.66
Amount Sudan grass hay consumed	2241.70	214.91	327.07	645.21	1035.66	18.84
2000 grams of darso fed.....	1765.60	38.60	235.20	76.40	1349.40	66.00
Amount consumed	4007.30	253.51	562.27	721.61	2385.60	84.84
1524 grams manure excreted (air dried)	1422.20	156.97	264.11	361.80	613.87	25.45
Grams digested	2585.10	96.54	298.16	359.81	1771.19	59.39
Minus Sudan grass hay digested...	1255.35	47.28	160.26	380.67	631.75	10.74
Darso digested	1329.75	*	137.90	———	1139.44	48.65
Per cent digested.....	75.31	*	58.63	———	84.44	73.71

—— minus quantity. * plus quantity.

TABLE NO. 4

Showing the amount of darso silage fed, the amount consumed and the digestion co-efficients.

Darso Silage

Sheep No. 1 (wether)	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
8000 grams of darso silage fed.....	2132.40	120.80	149.60	510.40	1318.40	34.40
1210 grams of darso silage not eaten	445.89	29.40	21.06	175.90	215.93	3.64
Amount consumed	1686.51	91.40	128.54	334.50	1102.47	30.76
802 grams manure excreted.....	761.82	68.09	113.48	234.18	332.11	13.95
Grams digested.....	924.69	23.31	15.06	100.32	770.36	16.81
Per cent digested.....	54.83	25.50	11.72	29.99	69.88	54.65
Sheep No. 2 (ewe)	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
8000 grams darso silage fed.....	2132.40	120.80	149.60	510.40	1318.40	34.40
1375 grams darso silage not eaten.	515.34	32.82	26.68	193.45	258.29	4.10
Amount consumed	1617.06	87.98	122.92	316.95	1060.11	30.30
834 grams manure excreted.....	792.63	87.24	136.36	212.42	344.03	12.59
Grams digested	824.43	.74	———	104.53	716.08	17.71
Per cent digested.....	50.98	.84	———	32.98	67.55	58.45
Sheep No. 3 (ram)	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
8000 grams of darso silage fed....	2132.40	120.80	149.60	510.40	1318.40	34.40
775 grams of darso silage not eaten	305.29	20.90	13.02	126.75	142.37	2.24
Amount consumed	1827.11	99.90	136.58	383.65	1176.03	32.16
721 grams manure excreted.....	687.11	66.26	124.52	178.09	307.36	10.89
Grams digested.....	1140.00	33.64	12.06	205.56	868.67	21.27
Per cent digested.....	62.39	33.67	8.83	53.58	73.86	66.14

TABLE NO. 5

Showing the amount of broomcorn seed fed, the amount consumed and the digestion co-efficients.

Broom Corn Seed

Sheep No. 1 (2-day collection period)	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
1200 grams Sudan grass hay fed...	1111.32	81.36	112.80	363.60	532.56	21.00
218.6 grams Sudan grass hay not eaten	206.29	14.89	19.02	68.20	101.02	3.17
Amount Sudan grass hay consumed	905.03	66.47	93.78	295.40	431.54	17.83
800 grams of broom corn seed eaten	719.52	34.16	106.96	72.32	476.96	29.12
Amount consumed	1624.55	100.63	200.74	367.72	908.50	46.95
713 grams manure excreted.....	671.65	65.45	121.57	161.14	314.15	9.34
Grams digested	952.90	35.18	79.17	206.58	594.35	37.61
Minus Sudan grass hay digested...	506.82	14.62	45.95	173.60	262.37	10.16
Broom corn seed digested.....	446.08	20.56	33.22	32.98	331.98	27.45
Per cent digested.....	62.00	60.19	31.06	45.60	69.60	94.27
Sheep No. 2 (4-day collection period)	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
2400 grams Sudan grass hay fed...	2222.64	162.72	225.60	727.29	1065.12	42.00
422 grams Sudan grass hay not eaten	398.49	27.22	32.62	143.06	191.17	4.43
Amount Sudan grass hay consumed.	1824.15	135.50	192.98	584.14	873.95	37.57
1600 grams of broom corn seed eaten	1439.04	68.32	213.92	144.64	953.92	58.24
Amount consumed	3263.19	203.82	406.90	728.78	1827.87	95.81
1480 grams manure excreted.....	1398.30	147.11	233.54	355.20	640.25	22.20
Grams digested	1864.89	56.71	173.36	373.58	1187.62	73.61
Minus Sudan grass hay digested...	1021.52	29.81	94.56	343.30	531.19	21.41
Broom corn seed digested.....	843.37	26.90	78.80	30.28	656.43	52.20
Per cent digested.....	58.60	39.38	36.84	20.93	68.82	89.62

TABLE NO. 6

Showing the amount of sunflower silage fed, the amount consumed and the digestion co-efficients.

Sunflower Silage

Sheep No. 1 (ewe)	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
10000 grams sunflower silage fed..	2803.70	322.78	296.30	867.02	1236.31	81.31
1871 grams sunflower silage not eaten	1739.47	205.25	205.44	508.16	765.43	55.19
Amount sunflower silage consumed.	1064.23	117.53	90.86	358.86	470.88	26.12
400 grams of manure excreted.....	374.40	78.52	79.88	83.36	120.76	11.88
Grams digested	689.83	39.01	10.98	275.50	350.12	14.24
Per cent digested.....	64.82	33.19	12.08	76.77	74.35	54.52

Sheep No. 2 (ram)	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
10000 grams sunflower silage fed..	2803.70	322.30	296.30	867.02	1236.31	81.31
1118.2 gms.sunflower silage not eaten	1053.68	102.09	62.62	446.27	430.51	12.19
Amount sunflower silage consumed.	1750.02	220.69	233.68	420.75	805.80	69.12
570 grams manure excreted.....	532.89	109.50	117.42	103.28	185.88	16.82
Grams digested	1217.13	111.19	116.26	317.47	619.92	52.30
Per cent digested.....	69.55	50.38	49.75	75.45	76.93	75.66

Sheep No. 3 (wether)	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
10000 grams sunflower silage fed..	2803.70	322.78	296.30	867.02	1236.31	81.31
1744 grams sunflower silage not eaten	1632.56	185.21	181.38	531.05	696.20	38.72
Amount sunflower silage consumed.	1171.14	137.57	114.92	335.97	540.11	42.59
540 grams manure excreted.....	505.39	96.66	105.35	116.42	172.48	14.47
Grams digested	665.75	40.91	9.57	219.55	367.63	28.12
Per cent digested.....	56.84	29.74	8.33	65.35	68.07	66.02

TABLE NO. 7

Average Co-Efficient of Digestion

	Dry Matter	Ash	Protein	Fiber	N. Free Extract	Fat
Sudan grass hay.....	56.0	22.0	46.8	58.7	60.7	57.0
Darso	72.8	———	56.5	———	84.0	68.9
Darso silage	56.0	29.5	10.2	See Table 4	70.0	59.7
Broom corn seed.....	60.3	*	33.9	*	69.2	91.9
Sunflower silage	63.7	*	See Table 6	72.4	73.0	70.5

*Wide variation.

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DISCUSSION OF RESULTS

A comparison of our digestion co-efficients for Sudan grass hay with those obtained at the Iowa Station shows a fairly close agreement. The per cent of protein digested was 46.8 in our experiments and 47.4 in the Iowa experiments. This would seem to indicate that the per cent, 35.4, obtained at the Maryland Station is too low. Comparing the co-efficients for fat we find that ours agrees closely with that of Iowa, indicating that the results of the Maryland Station are too low. Our results on Sudan grass do not agree so well with the Iowa experiments on some of the other constituents, but taking all of the co-efficients we find a fairly good agreement.

Table 7 shows a negative result for the digestibility of the ash and fibre in darso. This is undoubtedly due to the fact that Sudan grass hay was fed with the darso, and since there is such a relatively large amount of ash and fibre in the Sudan grass hay compared with that in darso, a slight error in the determinations or a slight change in the digestibility of these constituents in Sudan grass hay would affect the results for darso in such a way as to make them very much too large or very much too small. It is interesting to note that our average co-efficient for protein in darso is 56.5 compared with 56.2, which is the average given by Fraps in Texas Bulletin 166 for kafir. The average given by Fraps is that of six digestion trials made at three different stations. A comparison of the digestion co-efficient for the protein of darso and for darso silage given in Table No. 7 would lead one to suspect that one or the other of these results, or possibly both, are wrong.

However, it is well known that the proteins in silage are not as digestible as the proteins of the original substances. The co-efficient for sor-

ghum silage given by Fraps, Texas Bulletin 166, is 9.0, compared with our co-efficient 10.2 for darso silage. It is worth pointing out in this connection that the proteins of sunflower seed are highly digestible, whereas the digestion co-efficient obtained by us for the proteins of sunflower silage are very low. It may be that our co-efficient for proteins on sunflower silage is not correct, since one of the sheep gave a co-efficient of 49.7 and the other two gave 12.0 and 8.3. The low results, however, are in harmony with our results for the proteins of darso silage and with the results of the proteins of silages of other substances obtained at other stations.

Attention should be called to the small amount of sunflower silage consumed by the sheep compared with the amount of darso silage consumed and the amount of other feeds consumed in the several trials. Our notes on the five digestion experiments show that, with the exception of sunflower silage, the amount of feces excreted daily was quite uniform. In case of the sunflower silage the amount of feces on one day would be very small, and the next day probably five times the amount of the first day. While no record was kept of the weights of the sheep in these experiments, it was quite evident that the sheep had lost weight in the experiment with sunflower silage, and this, of course, would be expected, since they ate such a small amount of it. We found it impossible to get one sheep to eat sunflower silage, and all of them ate very little of it at first, and as our results show, ate only a small amount after they came to eat a uniform amount per day. In this experiment we did not begin keeping a record until several days had past, and the sheep had come to eat about the same amount of silage each day.

It is noted in Table 7 that widely varying results were obtained for the digestion co-efficient of the ash and fiber in our experiment with broomcorn seed. Our explanation for this is the same as that given for these constituents in our experiment with darso. As stated in the introduction, large amounts of broomcorn seed are produced in this state, a great part of which is allowed to go to waste. Since most of the threshing is done when the corn is not thoroughly ripe it would not be possible to save the green seed, but there is a large amount of seed that would serve well for feed purposes, and it might be possible to save the partially green seed by ensiling it with other substances. Two lines of work suggest themselves here in connection with broomcorn seed, one is that feeding experiments are needed to determine the value of the substance and the other is the possibility of saving the partially green seed by converting them into silage, using other field crops with them.