COMPOSITION OF SOUTH DAKOTA FEEDS [1]

A. W. Halverson and G. F. Gastler[2]
Station Biochemistry Section, Department of Chemistry
South Dakota State University, Brookings 57006

ABSTRACT

The chemical composition of South Dakota feeds was studied during the period from 1973 through 1975. Dry matter, proximate, calcium and phosphorus analysis data were obtained on alfalfa, corn and oat silages, on alfalfa, smooth bromegrass, oat and prairie hays and on corn and oat grains. The total digestible nutrients were calculated on these feeds. Other data included dry matter and protein (or protein alone) on the following feeds: barley, corn-sorghum, sorghum or Triticale silages; alfalfa, corn or sorghum green roughages; alfalfa-smooth bromegrass hay; sorghum dry roughage; corn stalks; millet or oat straws; and barley, milo, Triticale, spring wheat or winter wheat grains. Mean and standard deviation values were determined. The mean values obtained on each feed were compared with data published by the National Academy of Sciences (1971). In comparison to the published data, the results in the present study showed differences as follows: higher dry matter contents of alfalfa, barley, corn and oat silages and of green alfalfa; a lower crude fiber content of oat silage; a lower ether extract content of oat grain; lower protein contents of alfalfa-smooth bromegrass and smooth bromegrass hays; higher protein contents of corn-sorghum, oat and sorghum silages, of oat and prairie hays and sorghum dry roughage, of millet and oat straws, and of barley, hulless barley and oat grains; a lower calcium content of corn silage; a higher calcium content of smooth bromegrass hay; and a somewhat lower phosphorus content of alfalfa silage. The comparison of constituents of wet feeds was made on a dry basis. The range of the protein values for alfalfa silages and of the dry matter and protein values for corn and oat silages was found to be quite narrow; however, distribution of dry matter values for alfalfa silages was extensive.

INTRODUCTION

A comparison of the composition of some South Dakota feeds with the values in the Atlas of Nutritional Data on United States and Canadian Feeds as published by the National Academy of Sciences (1971) was of interest. The compilation of data on South Dakota feeds was made from data obtained by the Agricultural

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[2]Associate Professor Emeritus of Station Biochemistry.

Experiment Station of South Dakota State University in providing analytical services for the citizens of the state. The samples were sent in during the 1973, 1974 and 1975 crop years[3] from throughout the state.

PROCEDURE

The procedure of sample preparation for analysis is described. Wet samples were first dried in a forced draft oven at 75 C. for 48 hours. Weight measurements were made on the wet samples both before and after drying in order to permit calculation of dry matter. The weight of dried samples ordinarily ranged from 150 to 300 grams. These and other samples, which did not require drying, were ground in a Wiley mill using a 2 mm sieve. The ground material of each sample was mixed manually and a representative portion, i.e. about 50 g., was placed in an air-tight bottle for use in the analyses.

The determinations included dry matter, ash, crude fiber, ether extract, protein, nitrogen-free extract (required proximate analysis), calcium and/or phosphorus. In addition, the total digestible nutrients (TDN) were calculated from the results on the proximate analysis. The analyses were by methods described by the AOAC (1975) or by slight modifications of them. The TDN calculation involved the use of digestion coefficients for cattle as compiled by the National Academy of Sciences[4] (1971). The calculation of TDN was as follows: crude fiber x fiber coefficient + ether extract x ether extract coefficient x 2.25 + N-free extract x N-free extract coefficient + protein x protein coefficient.

In expressing constituents of a silage or wet roughage on a moisture-free basis, a dry matter determination on the ground sample (as prepared for analysis) was also necessary. Otherwise, an average dry matter value as determined on certain of the samples of the same kind of feed was used in the calculation. The average of the dry matter as determined on certain of the prepared samples of alfalfa, corn and oat silage was 95.05, 95.35 and 94.72%, respectively. While similar measurements were lacking for other kinds of wet roughage, the conversion of their constituents to a dry basis was approximated by using 95.00% as the assumed dry matter content of the prepared samples.

With each feed, the average values obtained for various constituents were compared with those published by the NAS (1971). The data (NAS, 1971) which were used for comparison were those listed under the general class of a feed, unless otherwise indicated

[3]Collection period: June 1, 1973 through May 31, 1976.
[4]Abbreviated in remainder of text: NAS.

in the results. Some examples of general classes are as follows: corn, aerial part, ensiled; corn, aerial part, fresh; brome, smooth, hay, sun-cured; oats, hay, sun-cured; native plants, midwest, hay, sun-cured (prairie hay); and oats, grain.

RESULTS AND DISCUSSION

The compositions of three common silages for the 1973-75 period are shown in Table 1. (Note that the results in Tables 2, 3 and 4 are also from the 1973-75 period.) Certain of the measurements (Table 1) on the alfalfa, corn and oat silages were as follows: dry matter—46.0, 35.6 and 44.2%, respectively; crude fiber (dry basis or M.F.)—28.8, 21.3 and 26.0%, respectively; protein (M.F.)—18.2, 9.5 and 11.9%, respectively; and total digestible nutrients or TDN (M.F.)—55.6[5], 66.0 and 56.3%, respectively. The published values by the NAS (1971) show the percent of dry matter and other constituents of alfalfa, corn and oat silages as follows: dry matter—38.1[6], 26.3 and 32.4, respectively; crude fiber (M.F.)—30.9[6], 23.1 and 35.5, respectively; protein (M.F.)—17.8[6], 8.9 and 8.9, respectively; and TDN (M.F.)—58.5[6], 65.7 and 58.6, respectively. A comparison of the above values for each silage with the data in Table 1 shows some differences. The dry matter contents shown in Table 1 were higher for each silage in comparison to the values given by the NAS (1971) reference, while the TDN content was slightly lower for the alfalfa silage. Also, the oat silage showed a slightly lower TDN value, a higher protein value and a lower crude fiber value.

The yearly averages for dry matter and for protein (M.F.) of each silage are shown in the lower part of Table 1. The dry matter averages for each of the corn and oat silages were not markedly different during the 3-year period. With alfalfa silage, the dry matter averages were somewhat variable. With regard to the protein averages, the results on each silage show that the protein content increased somewhat during the 3-year period. The increase in protein content was more noticeable with the oat silage than with either the alfalfa or corn silage. The extent to which silage additives affected the crude protein values was not determined.

The distribution of the samples of each silage for the 3-year period according to dry matter and protein (M.F.) contents is shown in Figures 1 and 2. As shown in Figure 1, the alfalfa silage samples

[5]Of the 30 alfalfa samples which were used to obtain this average, 7 were classed as non-wilted (less than 33.2% of dry matter) and 23 were classed as wilted (more than 33.2% of dry matter). The digestion coefficients reported by the NAS (1971) for non-wilted alfalfa silage (alfalfa, aerial part, ensiled) and for wilted alfalfa silage (alfalfa, aerial part, wilted ensiled) were used for the individual calculations.

[6]Alfalfa, aerial part, wilted ensiled.

TABLE 1

Composition of Common Silages[1]

Measurement		Percent of Different Constituents		
		Alfalfa Silage	Corn Silage	Oat Silage
As received basis (A.R.) —				
Total dry matter		46.03 ± 14.17 (169)	35.56 ± 9.02 (368)	44.18 ± 10.40 (75)
Moisture-free basis (M.F.) —				
Ash		11.02 ± 1.88 (30)	6.71 ± 1.79 (70)	11.23 ± 2.87 (14)
Crude fiber		28.78 ± 3.35 (35)	21.30 ± 2.51 (85)	25.98 ± 3.34 (23)
Ether extract		2.09 ± 0.68 (31)	1.96 ± 0.72 (73)	3.13 ± 0.52 (15)
Nitrogen-free extract		39.50 ± 3.12 (30)	60.91 ± 3.86 (69)	47.22 ± 3.93 (14)
Protein (N x 6.25)		18.21 ± 2.61 (167)	9.51 ± 1.62 (362)	11.92 ± 2.30 (75)
Total digestible nutrients		55.64 ± 1.56 (30)	65.97 ± 1.85 (69)	56.34 ± 2.06 (14)
Calcium		1.56 ± 0.27 (19)	0.30 ± 0.10 (43)	0.35 ± 0.11 (8)
Phosphorus		0.22 ± 0.05 (20)	0.19 ± 0.04 (46)	0.26 ± 0.04 (8)
Yearly values —				
Total dry matter	1973	43.86 ± 12.85 (44)	36.10 ± 7.84 (102)	43.21 ± 6.63 (21)
	1974	47.64 ± 14.93 (61)	35.50 ± 10.48 (149)	44.58 ± 10.15 (30)
	1975	45.99 ± 14.30 (64)	35.17 ± 7.98 (117)	43.95 ± 15.46 (24)
Protein (M.F.)	1973	17.99 ± 2.99 (43)	9.05 ± 1.45 (96)	10.73 ± 1.73 (21)
	1974	18.03 ± 2.92 (61)	9.44 ± 1.88 (149)	12.26 ± 2.49 (30)
	1975	18.54 ± 1.94 (63)	9.83 ± 1.76 (117)	12.55 ± 2.17 (24)

[1]The data of Tables 1, 2, 3 and 4 include mean values ± standard deviation and the number of samples (in parenthesis) involved with each measurement. The samples were from the 1973, 1974 and 1975 crop years.

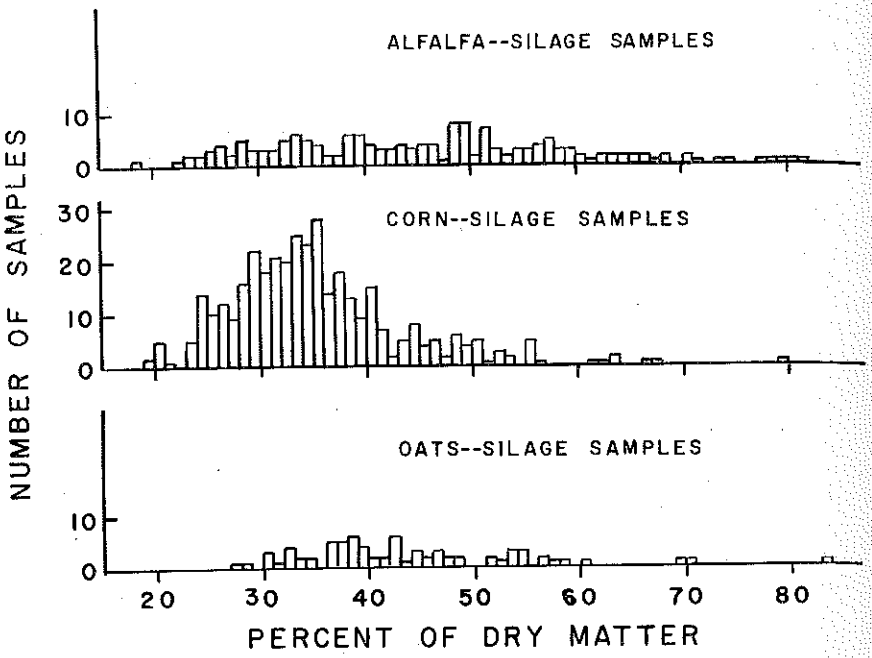

Figure 1. Distribution of samples of alfalfa, corn or oat silage according to dry matter content during the 1973-75 period.

varied greatly in dry matter content. Compared to the dry matter distribution with alfalfa silage, that for either corn or oat silage was less broad. The corn silages ranged in dry matter from about 20 to 64%, with the majority of samples in the range between 23 and 51%. The pattern of dry matter distribution with the corn silage was quite symmetrical, the maximum occurrence of samples being at about 35% of dry matter. Only a limited number of dry matter determinations were made on oat silages. The oat silages appeared to range in dry matter from about 27 to 60%, with the majority of the samples found in the range from 30 to 57%.

Protein distributions for each silage are shown in Figure 2. The ranges in protein content for most of the samples of different silages were reasonably narrow, i.e., from about 16 to 21% (alfalfa silage), 7 to 12% (corn silage) and 9 to 15% (oat silage). The patterns of distribution were quite symmetrical with the alfalfa and corn silages, the peak occurrence of samples being at about 19% of protein for alfalfa silages and at about 9% of protein for corn silages. The limited number of oat silage samples which were involved in protein determinations did not provide data for a comprehensive picture.

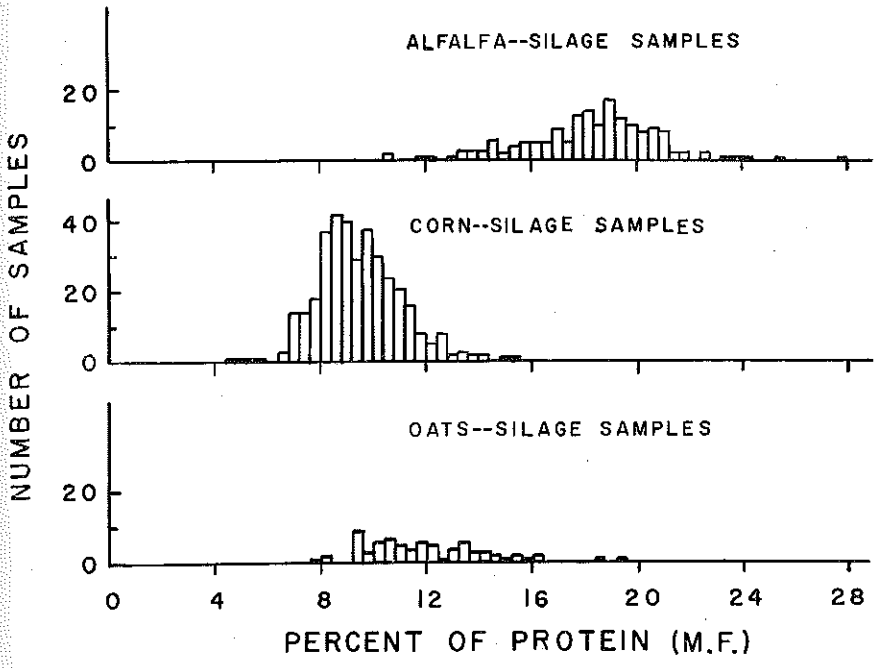

Figure 2. Distribution of samples of alfalfa, corn or oat silage according to protein content on a dry basis during the 1973-75 period.

The alfalfa, corn and oat silages had calcium contents (M.F.) of 1.56, 0.30 and 0.35%, respectively, and phosphorus contents (M.F.) of 0.22, 0.19 and 0.26%, respectively (Table 1). The NAS (1971) publication shows alfalfa, corn and oat silages to contain calcium (M.F.) at 1.40°, 0.50 and 0.36%, respectively, and to contain phosphorus (M.F.) at 0.33°, 0.20 and 0.25%, respectively. In comparison to the latter values, the alfalfa silages of the present study were somewhat lower in phosphorus and slightly higher in calcium. Also, the corn silages were lower in calcium.

The comparison of dry matter data on the alfalfa and oat silages (Table 1) with those of a previous study (Voelker and Halverson, 1976) was of interest. The work of Voelker and Halverson (1976) which included several feeds taken from the South Dakota Agricultural Experiment Station Dairy Farm at Brookings, South Dakota, reported dry matter of alfalfa and oat silages at 57.2 and 45.5%, respectively. The mean values for dry matter of alfalfa and oat silages in the present study were 46.0 and 44.2%, respectively (Table 1). Protein data for each of the silages were comparable in the two studies.

TABLE 2

Composition of Common Hays

Measurement		Percent of Different Constituents			
		Alfalfa Hay	Smooth Bromegrass Hay	Oat Hay	Prairie Hay
As received basis —					
Total dry matter		85.10 ± 6.16 (60)	92.07 ± 2.73 (6)	86.29 ± 6.42 (21)	90.23 ± 4.34 (18)
Crude fiber		26.98 ± 5.21 (28)	29.17 ± 3.01 (7)	24.21 ± 4.44 (11)	34.62 ± 4.96 (14)
Protein (N x 6.25)		15.26 ± 2.41 (236)	7.92 ± 1.88 (16)	10.05 ± 2.08 (66)	7.30 ± 2.46 (45)
Calcium		1.27 ± 0.40 (30)	0.48 ± 0.20 (5)	0.21 ± 0.06 (6)	
Phosphorus		0.17 ± 0.04 (29)	0.13 ± 0.03 (5)	0.20 ± 0.03 (6)	
Moisture-free basis —					
Ash		10.51 ± 2.14 (21)	9.67 ± 2.34 (5)	9.16 ± 1.87 (7)	7.43 ± 2.38 (5)
Crude fiber		30.23 ± 5.04 (28)	32.12 ± 3.58 (6)	27.81 ± 5.86 (12)	38.24 ± 5.69 (13)
Ether extract		1.48 ± 0.50 (21)	1.25 ± 0.30 (5)	2.02 ± 0.70 (9)	1.61 ± 0.83 (12)
Nitrogen-free extract		40.95 ± 4.10 (21)	49.33 ± 3.61 (5)	48.04 ± 3.48 (7)	45.14 ± 9.67 (5)
Protein (N x 6.25)		17.08 ± 2.71 (60)	7.79 ± 2.54 (6)	10.48 ± 2.42 (21)	8.10 ± 2.78 (18)
Total digestible nutrients		53.67 ± 1.65 (21)	52.79 ± 1.06 (5)	57.72 ± 1.80 (7)	52.69 ± 2.52 (5)
Calcium		1.37 ± 0.32 (14)	0.57 ± 0.20 (4)	0.24 ± 0.06 (4)	
Phosphorus		0.20 ± 0.03 (13)	0.13 ± 0.02 (4)	0.22 ± 0.03 (4)	
Yearly values —					
Total dry matter	1973	83.54 ± 5.83 (14)			
	1974	87.95 ± 4.21 (20)			
	1975	83.74 ± 6.98 (26)			
Protein (A.R.)	1973	14.73 ± 2.55 (70)			
	1974	15.36 ± 2.27 (102)			
	1975	15.61 ± 2.47 (65)			

The compositions of four common hays are reported in Table 2. The mean values for certain measurements on alfalfa, smooth bromegrass, oat and prairie hays were as follows: dry matter—85.1, 92.1, 86.3 and 90.2%, respectively; crude fiber (M.F.)—30.2, 32.1, 27.8 and 38.2%, respectively; protein (M.F.)—17.1, 7.8, 10.5 and 8.1%, respectively; and TDN (M.F.)—53.7, 52.8, 57.7 and 52.7%, respectively. The NAS (1971) values (in percent) for these same constituents in alfalfa, smooth bromegrass, oat and prairie hays were as follows: dry matter—91.4, 89.7, 90.7 and 91.0, respectively; crude fiber (M.F.)—30.6, 31.8, 30.8 and 33.7, respectively; protein (M.F.)—17.0, 11.7, 8.5 and 6.4, respectively; and TDN (M.F.)—53.8, 55.5, 60.0 and 52.9, respectively. Values for the present study, compared to the published data (NAS, 1971), were somewhat lower for dry matter in alfalfa hays, for TDN and especially protein in brome hays and for dry matter, crude fiber and TDN in oat hays, and were higher for protein in oat hays and for crude fiber and protein in prairie hays.

The yearly averages for the dry matter and protein (A.R.) in alfalfa hays are shown in Table 2. Over the 3-year period, the dry matter was somewhat variable but showed no trend; however, an increase was shown in the protein content.

Calcium and phosphorus analysis data are presented for some of the hays (Table 2). The alfalfa, smooth bromegrass and oat hays had calcium contents (M.F.) of 1.37, 0.57 and 0.24%, respectively, and phosphorus contents (M.F.) of 0.20, 0.13 and 0.22%, respectively. The reference of the NAS (1971) lists the calcium content (M.F.) of alfalfa, brome and oat hays at 1.41, 0.36 and 0.24%, respectively, and the phosphorus content (M.F.) at 0.24, 0.19 and 0.22%, respectively. As compared to the data of the NAS (1971), the present results were in general agreement, except that the brome hay was somewhat lower in phosphorus and higher in calcium.

Data on alfalfa hays were also included in the previous report on feeds (Voelker and Halverson, 1976). The proximate composition (M.F.) given in that report was in general agreement with that shown for alfalfa hay in Table 2. However, the earlier value for crude fiber of 26.8% was lower than the present value of 30.2% for that constituent. Also, the earlier value for protein of 18.5% was higher than the present value of 17.1% for protein.

The results (see Table 3) on additional roughages, i.e., barley, corn-sorghum, sorghum and Triticale silages, were as follows (in percent): dry matter—49.6, 32.3, 35.6 and 44.8, respectively; and protein (M.F.)—10.7, 9.4, 8.8 and 11.8, respectively. The data of the NAS (1971), which did not include information on Triticale silage, shows barley, corn-sorghum and sorghum silages to contain dry

TABLE 3

Composition of Other Silages and Roughages

Measurement	Percent of Different Constituents			
	Barley Silage	Corn-Sorghum Silage	Sorghum Silage	Triticale Silage
As received basis —				
Total dry matter	49.55 ± 10.99 (5)	32.26 ± 7.32 (7)	35.55 ± 8.40 (12)	44.81 ± 9.08 (6)
Moisture-free basis —				
Protein (N x 6.25)	10.69 ± 3.29 (5)	9.35 ± 1.76 (7)	8.84 ± 3.05 (12)	11.84 ± 2.81 (6)
	Alfalfa, Green Roughage	Corn, Green Roughage	Sorghum, Green Roughage	Corn Stalks, Fresh
As received basis —				
Total dry matter	44.06 ± 15.09 (19)	30.61 ± 10.89 (31)	31.55 ± 9.55 (23)	63.24 ± 29.40 (13)
Moisture-free basis —				
Crude fiber		24.17 ± 2.41 (4)		34.63 ± 3.40 (4)
Protein (N x 6.25)	18.93 ± 2.80 (17)	10.27 ± 1.42 (22)	10.27 ± 2.70 (5)	4.85 ± 0.58 (5)
	Alfalfa-Smooth Bromegrass Hay	Sorghum, Dry Roughage	Millet Straw	Oat Straw
As received basis —				
Total dry matter	87.00 ± 5.50 (7)	81.40 ± 5.69 (7)		
Protein (N x 6.25)	10.20 ± 2.61 (21)	7.96 ± 1.19 (6)	8.76 ± 3.30 (10)	7.53 ± 3.64 (11)
Calcium	0.84 ± 0.21 (6)			
Phosphorus	0.18 ± 0.05 (6)			
Moisture-free basis —				
Protein (N x 6.25)	11.83 ± 2.78 (6)	9.78 ± 1.18 (6)		

matter at 25.0, 34.6[7] and 33.9[8]%, respectively, and protein (M.F.) at 10.4, 7.9[7] and 7.5[8]%, respectively. As compared to the NAS (1971) values, higher dry matter contents were found in the barley silages of the present study. Somewhat higher protein contents were also evident in the sorghum and corn-sorghum silages.

The analysis of other wet roughages, i.e., green alfalfa, green corn, green sorghum and corn stalks, showed contents (see Table 3) as follows: dry matter—44.1, 30.6, 31.6 and 63.2%, respectively; and protein (M.F.)— 18.9, 10.3, 10.3 and 4.9%, respectively. For the green alfalfa, green corn, green sorghum and corn stalk roughages, the data of the NAS (1971) show the dry matter at 25.9, 22.6, 25.5[9] and 56.2%, respectively, and protein (M.F.) at 21.9, 9.1, 5.9[9] and 5.9%, respectively. In comparison with the published data (NAS, 1971), the dry matter of each roughage of the present study was somewhat higher. This was most marked for the green alfalfa. Also, the protein content was somewhat lower for green alfalfa and higher for green sorghum.

Other results (see Table 3) show alfalfa-smooth bromegrass hay and sorghum dry roughage with dry matter contents of 87.0 and 81.4%, respectively, and with protein contents (M.F.) of 11.8 and 9.8%, respectively. With alfalfa-brome hay, the calcium and phosphorus contents on an as received basis (A.R.) were 0.84 and 0.18%, respectively (Table 3). NAS (1971) data show alfalfa-smooth bromegrass hay to have dry matter, protein (M.F), calcium (A.R.) and phosphorus (A.R.) contents of 82.5, 16.2, 0.85 and 0.25%, respectively. Also, this reference shows sorghum dry roughage to have dry matter and protein (M.F.) contents of 90.3[10] and 6.2[10]%, respectively. As compared to the data of the NAS (1951), the alfalfa-brome hays (Table 3) were lower in protein and to some extent in phosphorus, but somewhat higher in dry matter. Similarily, the sorghum dry roughages were somewhat lower in dry matter and higher in protein.

Protein measurements (A.R.) on millet and oat straws gave values of 8.8 and 7.5%, respectively (Table 3). NAS (1971) data show millet and oat straws to have protein contents (A.R.) of 3.8 and 3.8%, respectively. Thus, the protein contents of both of these straws were considerably higher in the present study.

The results of the grain analyses are shown in Table 4. Dry matter, protein, calcium and phosphorus determinations were made on barley; dry matter, proximate, calcium and phosphorus determi-

[7]Corn-sorghum aerial part, ensiled, mature.
[8]Sorghum aerial part, ensiled, mature.
[9]Sorghum aerial part, fresh, dough stage.
[10]Sorghum, aerial part, dehydrated.

TABLE 4

Composition of Grains

Measurement	Barley	Corn, dent	Oats
	Percent of Different Constituents		
As received basis —			
Total dry matter	89.73 ± 1.34 (4)	81.20 ± 6.55 (29)	90.20 ± 1.63 (19)
Protein (N x 6.25)	13.51 ± 2.26 (42)	9.00 ± 1.14 (79)	14.35 ± 1.72 (97)
Calcium	0.060 ± 0.016 (7)	0.017 ± 0.008 (7)	0.091 ± 0.023 (7)
Phosphorus	0.34 ± 0.048 (7)	0.27 ± 0.024 (9)	0.35 ± 0.034 (9)
Moisture-free basis —			
Ash		2.01 ± 0.75 (7)	4.05 ± 0.62 (6)
Crude fiber		2.84 ± 0.84 (8)	12.01 ± 2.44 (6)
Ether extract		3.53 ± 0.92 (6)	1.97 ± 0.57 (6)
Nitrogen-free extract		80.90 ± 0.91 (6)	65.97 ± 3.77 (6)
Protein (N x 6.25)		11.02 ± 0.73 (17)	16.08 ± 2.11 (19)
Total digestible nutrients		89.27 ± 1.52 (6)	70.67 ± 1.97 (6)
Calcium		0.023 ± 0.013 (5)	0.095 ± 0.006 (4)
Phosphorus		0.30 ± 0.029 (7)	0.40 ± 0.042 (5)
	Hulless barley	Milo	Triticale
As received basis — Protein (N x 6.25)	16.71 ± 2.02 (9)	10.99 ± 1.81 (6)	16.10 ± 1.24 (5)
	Spring wheat	Winter wheat	
As received basis — Protein (N x 5.7)	15.09 ± 1.32 (18)	13.20 ± 1.83 (34)	

nations were made on corn and oats and; protein determinations were made on hulless barley, milo, Triticale, spring wheat and winter wheat. Since the number of dry matter determinations on barley were limited, the data for that grain are presented on an as received basis only. Dry matter and other determinations were more extensive for corn and oats and the data on these grains are presented on both the as received and moisture-free bases. On the as received basis, certain results on barley, corn and oats were as follows (in percent): dry matter—89.7, 81.2 and 90.2, respectively; protein—13.5, 9.00 and 14.4, respectively; calcium—0.06, 0.02 and 0.09, respectively; and phosphorus—0.34, 0.27 and 0.35, respectively (Table 4). Published data (NAS, 1971) show barley, corn and oat grains to have dry matter contents of 89.0, 87.2[11] and 88.9%, respectively; protein (A.R.) at 11.6, 8.9[11] and 11.7%, respectively; calcium (A.R.) at 0.07, 0.03[11] and 0.09%, respectively; and phosphorus (A.R.) at 0.40, 0.27[11] and 0.33%, respectively. In comparison to the published data (NAS, 1971), the barley grain samples of the present study were somewhat higher in protein. Also, the corn was somewhat lower in dry matter while the oats was higher in protein.

Expressing the data on corn and oats on the moisture-free basis gave values as follows for certain constituents: ether extract—3.5 and 2.0%, respectively; protein—11.0 and 16.1%, respectively; TDN—89.3 and 70.7%, respectively; calcium—0.02 and 0.10%, respectively; and phosphorus—0.30 and 0.40%, respectively. For corn and oats, the NAS (1971) data (M.F.) show ether extract values of 4.3 and 5.1%, respectively; protein values of 10.2 and 13.2%, respectively; TDN values of 90.4 and 74.5%, respectively; calcium values of 0.03 and 0.10%, respectively; and phosphorus values of 0.31 and 0.37%, respectively. The protein content (M.F.) of the oats in the present study was higher than published values (NAS, 1971); also, the protein content of the corn in the present study was slightly higher. Further, the corn samples of the present study were somewhat lower in ether extract, and the oats were lower in ether extract (and to some extent in TDN).

The results on grains which were analyzed for protein only were as follows (in percent, A.R.): hulless barley, 16.7; milo, 11.0; Triticale, 16.1; spring wheat, 15.1; and winter wheat, 13.2. The data of the NAS (1971) show the protein content (A.R.) of hulless barley, milo, spring wheat and winter wheat at 12.5, 10.9[12], 13.5[13] and 12.1[14]%, respectively (data on Triticale were not given). In comparison to

[11]Corn, dent, grain.

[12]Sorghum, milo, grain.

[13]Wheat, hard red spring, grain.

[14]Wheat, hard red winter, grain.

the values shown by the NAS (1971), hulless barley (Table 4) was higher in protein. Also, the spring wheat and winter wheat were somewhat higher in protein. Another reference (Morrison, 1976) lists the protein content (A.R.) of Triticale at 15.2%; therefore, the protein value of 16.1% (Table 4) is slightly higher.

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