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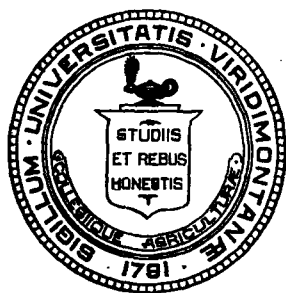
University of Vermont and State Agricultural College

Vermont Agricultural Experiment Station

BURLINGTON, VERMONT

THE DIGESTIBILITY OF ARTIFICIALLY
DRIED GRASS

By J. A. NEWLANDER *and* C. H. JONES



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Digestion trials with dairy cows fed solely on artificially dried young grass and on fresh green young grass indicated that both are highly digestible and essentially equally digestible. On a basis of 90.17 percent dry matter the total digestible nutrient contents of the dried grass was 64.37 percent and of the green grass 63.36 percent.

In trials comparing a ration of timothy hay, corn silage and dried grass with a ration of timothy hay, corn silage and grain, some variation was observed in the digestibility of the various nutrients in the two rations. The dry matter, crude protein and nitrogen free extract contents of the two rations were not dissimilar but marked differences occurred with those of crude fiber and ether extract. The crude fiber of the grain ration was 16.7 percent less digestible than that of the dried grass ration, while on the other hand the ether extract in the dried grass ration was 30.1 percent less digestible than that in the grain ration.

Mineral balances of calcium and phosphorus obtained in the digestion trials show no indication of greater availability of these minerals in the dried and green grass rations than in the grain ration.

BULLETIN 348: THE DIGESTIBILITY OF ARTIFICIALLY DRIED GRASS

By J. A. NEWLANDER and C. H. JONES

The feeding value of artificially dried roughages of various kinds assumes added importance with the increasing installation of hay-drying machines in this and other countries. A hay drier of a well-known make was installed at this Station in May, 1931. It has been used since that time in drying various leguminous roughages but more particularly for drying young grass harvested by means of power lawn mowers equipped with catchers. The intervals between cuttings ranged from seven to ten days and the grass was always of young growth. Feeding trials with dairy cows now in progress are designed to determine to what extent such grass when artificially dried may replace concentrates. Obviously digestion trials of this artificially dried young grass must precede such feeding trials.

The present publication sets forth the results obtained from two sets of digestion trials with dairy cows:

I. A comparison of the digestibility of artificially dried young grass with that of the same lot of green grass from which the dried material was obtained.

II. A comparison of the digestibility of an entire ration composed of timothy hay, corn silage and dried grass with that of a ration of timothy hay, corn silage and grain.

Mineral balances (calcium and phosphorus) were determined in order to ascertain what differences in their metabolism occurred when these several rations were fed.

PROCEDURE

Four cows, one pair at a time, were used in each trial, the reversal method being followed. Each collection period was two weeks and the adjustment period one week long in trial I and both two weeks long in trial II. The animals were exercised twice daily for 15-minute periods by leading in a yard, attendants following closely to catch excrement if voided. Three men, in eight-hour shifts, were in constant attendance to collect and keep feces separate from the urine. The feces as voided were kept in tightly covered cans and weighed and sampled daily. Weekly composites were made by taking five percent portions daily and placing them in a tightly covered receptacle, 5 c.c. of chloroform being added daily with each new aliquot as a preservative. A 3,500-gram sample was taken for analysis from each well mixed composite and as

a check on possible nitrogen losses a small daily sample of feces was subjected to immediate analysis for its nitrogen content.

In order to obtain data touching mineral balances all voidings of urine were collected. A weekly composite was made by weighing 10 percent of each day's voiding into a can large enough to contain the seven aliquots. Chloroform—1 c.c. to 4 pounds—was used as a preservative and, in addition, the can was kept in ice water. The composite sample was mixed at the end of the week and two quarts used for analysis.

Each day's milk was composited for a week and then analyzed, formalin being used as a preservative.

In the first trial enough green grass was cut daily for each day's ration of both green and dried grass. The green material was thoroughly mixed by shoveling, then one-half was put through the hay drier and the other left in the green state. Each was then mixed, sampled and individual feedings weighed out for a 24-hour period.

In the second trial, comparing the digestibility of entire rations, the individual feedings of hay, dried grass and grain were sampled and weighed out for the two weeks which comprised the trial period. The silage was weighed and sampled daily. The grain mixture was made up in the following proportions (by weight): corn meal five, ground oats three, wheat bran three, gluten feed three, linseed oil meal four, and cottonseed meal two. One percent of salt was added to this mixture.

The cows were weighed on three consecutive days at the beginning and end of each period.

As stated above, the collection periods were two weeks in length but all calculations were made by weekly periods and are so reported in the tables.

TRIAL I—DIGESTIBILITIES OF DRIED YOUNG AND OF GREEN YOUNG GRASS

The comparison was made of dried young grass with that of green young grass obtained from identical freshly cut lots. No other food, except salt, was used. Dry cows or those yielding only a moderate amount of milk were used since it was not possible to feed sufficient amounts alone of either green or dried grass to meet the nutrient requirements of heavily milking cows.

Four registered Ayrshires (Nos. 24, 50, 83, 85) were used, one pair at a time. Cows 24 and 50 were paired together as were 83 and 85. One cow was fed green grass and the other dried grass for a

period of two weeks and then the feeding was reversed for a like period, allowing one intermediate week for the adjustment. From 60 to 70 pounds of green grass or from 16 to 20 pounds of the dried grass was fed each cow daily, which was as much as they would readily consume without leaving orts. Salt bricks were kept before the animals at all times.

Cows 24 and 50 were on trial during the summer of 1931 and cows 83 and 85 during the summer of 1932. Cow 24 was dry and cow 50 yielded from 13 to 18 pounds of milk daily. Cows 83 and 85 gave 11 to 13 pounds of milk daily at the outset, but were dry by the last week of the trial. Initial and final weights were: cow 24, 1,075 and 1,140 pounds; cow 50, 980 and 1,035 pounds; cow 83, 1,095 and 1,162 pounds; cow 85, 1,018 and 1,060 pounds. The first three gained six percent, the last four percent in weight during the trials.

CHEMICAL COMPOSITION

The composition of the dried and of the green grass as fed by weekly periods is shown in tables 1 and 2. The figures vary somewhat

TABLE 1.—COMPOSITION OF DRIED GRASS AS FED

Cow	Period	Date	Water	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract	Calcium	Phosphorus
24	1	6/22-29/31	12.04	87.96	7.27	20.11	16.25	40.99	3.34	0.615	0.371
"	"	6/29-7/6	12.15	87.85	8.34	18.89	17.54	39.77	3.31	0.674	0.373
50	2	7/13-20	13.92	86.08	7.49	19.28	16.61	38.81	3.89	0.623	0.407
"	"	7/20-27	13.33	86.67	8.09	20.32	16.67	37.21	4.38	0.689	0.464
83	2	7/11-18/32	4.92	95.08	8.45	22.10	17.80	43.32	3.41	0.646	0.474
"	"	7/18-25	9.03	90.97	7.90	20.46	16.77	42.16	3.68	0.613	0.351
85	1	6/20-27	5.53	94.47	8.29	21.07	18.37	43.31	3.43	0.607	0.456
"	"	6/27-7/4	7.75	92.25	7.85	19.70	16.36	44.58	3.76	0.730	0.385
Average			9.83	90.17	7.96	20.24	17.05	41.27	3.65	0.650	0.410

TABLE 2.—COMPOSITION OF GREEN GRASS AS FED

Cow	Period	Date	Water	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract	Calcium	Phosphorus
24	2	7/13-20/31	76.31	23.69	2.27	5.25	4.77	10.32	1.08	0.181	0.111
"	"	7/20-27	76.44	23.56	2.49	5.72	4.53	9.53	1.24	0.202	0.132
50	1	6/22-29/31	69.75	30.25	2.78	7.19	5.69	13.30	1.29	0.222	0.136
"	"	6/29-7/6	69.88	30.12	3.21	6.64	6.18	12.88	1.21	0.242	0.137
83	1	6/20-27/32	75.94	24.06	2.42	5.45	4.65	10.68	0.86	0.173	0.117
"	"	6/27-7/4	77.70	22.30	2.35	4.83	4.16	10.08	0.88	0.188	0.096
85	2	7/11-18	76.48	23.52	2.50	5.53	4.65	9.93	0.91	0.174	0.121
"	"	7/18-25	77.37	22.63	2.57	5.35	4.28	9.47	0.96	0.165	0.094
Average			74.98	25.02	2.57	5.75	4.87	10.78	1.05	0.193	0.118

but no notable differences occurred except in respect to the dry matter content in the dried grass. This averaged a little over six percent more in 1932 than in 1931. This drier product was purposely obtained, since each day's run could be more promptly stored in the mow without heating than would have been possible had the dried grass had a higher water content.

RESULTS

The amounts of the different nutrients eaten, voided and digested weekly by each cow, together with the coefficients of digestibility obtained when feeding dried grass and when feeding green grass appear in tables 3 and 4. In order to facilitate comparison the coefficients are listed separately in tables 5 and 6. It will be noted that on the whole the two grasses are not materially unlike in respect to digestibility. The average coefficients for dry matter, ash, crude fiber and nitrogen

TABLE 3.—DIGESTIBILITY OF ARTIFICIALLY DRIED GRASS VERSUS DIGESTIBILITY OF GREEN GRASS

Trial I	Period 1—Dried grass						Period 2—Green grass					
	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract
Cow	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams
No. 24	First week 6/22-29/31						First week 7/13-20/31					
Nutrients consumed	44,684	3,693	10,216	8,255	20,823	1,697	44,585	4,272	9,880	8,977	19,423	2,033
Excrement	11,609	2,067	2,559	2,158	4,042	783	12,817	2,528	2,331	2,340	4,307	1,311
Nutrients digested	33,075	1,626	7,657	6,097	16,781	914	31,768	1,744	7,549	6,637	15,116	722
Coefficients of digestibility	74.	44.	75.	73.9	80.6	53.9	71.3	40.8	76.4	73.9	77.8	35.5
	Second week 6/29-7/6/31						Second week 7/20-27/31					
Nutrients consumed	44,628	4,237	9,596	8,910	20,204	1,681	44,458	4,699	10,794	8,642	17,983	2,340
Excrement	11,537	2,480	2,516	1,944	3,625	972	11,958	2,576	2,186	2,111	3,830	1,255
Nutrients digested	33,091	1,757	7,080	6,966	16,579	709	32,500	2,123	8,608	6,531	14,153	1,085
Coefficients of digestibility	74.1	41.5	73.8	78.2	82.1	42.2	73.1	45.2	79.7	75.6	78.7	46.4
	Period 1—Green grass						Period 2—Dried grass					
No. 50	First week 6/22-29/31						First week 7/13-20/31					
Nutrients consumed	57,626	5,296	13,697	10,839	25,337	2,457	52,319	4,552	11,718	10,096	23,589	2,364
Excrement	17,081	2,942	3,105	3,279	6,421	1,334	13,265	2,182	3,300	2,555	4,082	1,146
Nutrients digested	40,545	2,354	10,592	7,560	18,916	1,123	39,054	2,370	8,418	7,541	19,507	1,218
Coefficients of digestibility	70.4	44.4	77.3	69.7	74.7	45.7	74.6	52.1	71.8	74.7	82.7	51.5
	Second week 6/29-7/6/31						Second week 7/20-27/31					
Nutrients consumed	56,836	6,057	12,530	11,662	24,304	2,283	55,035	5,137	12,903	10,585	23,629	2,781
Excrement	17,564	3,763	3,190	2,968	6,147	1,496	15,250	2,939	3,401	2,826	4,563	1,521
Nutrients digested	39,272	2,294	9,340	8,694	18,157	787	39,785	2,198	9,502	7,759	19,066	1,260
Coefficients of digestibility	69.1	37.9	74.5	74.5	74.7	34.5	72.3	42.8	73.6	73.3	80.7	45.3

TABLE 4.—DIGESTIBILITY OF ARTIFICIALLY DRIED GRASS VERSUS DIGESTIBILITY OF GREEN GRASS

Trial I	Period 1—Green grass						Period 2—Dried grass					
	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract
Cow	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams
No. 83	First week 6/20-27/32						First week 7/11-18/32					
Nutrients consumed	53,477	5,379	12,113	10,335	23,738	1,912	60,380	5,366	14,034	11,304	27,510	2,166
Excrement	14,410	3,793	2,757	2,283	4,417	1,160	18,552	3,934	4,324	3,273	5,664	1,357
Nutrients digested	39,067	1,586	9,356	8,052	19,321	752	41,828	1,432	9,710	8,031	21,846	809
Coefficients of digestibility	73.1	29.5	77.2	77.9	81.4	39.3	69.3	26.7	69.2	71.	79.4	37.4
	Second week 6/27-7/4/32						Second week 7/18-25/32					
Nutrients consumed	49,261	5,191	10,670	9,190	22,266	1,944	57,770	5,017	12,993	10,650	26,773	2,337
Excrement	13,904	3,193	2,689	2,196	4,717	1,109	15,495	3,647	3,696	2,742	4,287	1,123
Nutrients digested	35,357	1,998	7,981	6,994	17,549	835	42,275	1,370	9,297	7,908	22,486	1,214
Coefficients of digestibility	71.8	38.5	74.8	76.1	78.8	42.9	73.2	27.3	71.6	74.3	84.	51.9
	Period 1—Dried grass						Period 2—Green grass					
No. 85	First week 6/20-27/32						First week 7/11-18/32					
Nutrients consumed	59,993	5,265	13,380	11,666	27,504	2,178	47,263	5,024	11,112	9,344	19,954	1,829
Excrement	16,757	3,070	4,475	3,256	4,737	1,219	14,773	4,098	2,672	2,435	4,365	1,203
Nutrients digested	43,236	2,195	8,905	8,410	22,767	959	32,490	926	8,440	6,909	15,589	626
Coefficients of digestibility	72.1	41.7	66.6	72.1	82.8	44.	68.7	18.4	76.	73.9	78.1	34.2
	Second week 6/27-7/4/32						Second week 7/18-25/32					
Nutrients consumed	58,582	4,985	12,510	10,389	28,310	2,388	42,846	4,866	10,129	8,104	17,929	1,818
Excrement	17,671	3,380	4,213	3,207	5,550	1,321	12,715	3,331	2,444	2,140	3,736	1,064
Nutrients digested	40,911	1,605	8,297	7,182	22,760	1,067	30,131	1,535	7,685	5,964	14,193	754
Coefficients of digestibility	69.8	32.2	66.3	69.1	80.4	44.7	70.3	31.5	75.9	73.6	79.2	41.5

TABLE 5.—COEFFICIENTS OF DIGESTIBILITY OBTAINED IN TRIAL I ON RATION OF DRIED GRASS

Cow	Date	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract
24	6/22-29/31	74.	44.	75.	73.9	80.6	53.9
"	6/29-7/6/31	74.1	41.5	73.8	78.2	82.1	42.2
50	7/13-20/31	74.6	52.1	71.8	74.7	82.7	51.5
"	7/20-27/31	72.3	42.8	73.6	73.3	80.7	45.3
83	7/11-18/32	69.3	26.7	69.2	71.	79.4	37.4
"	7/18-25/32	73.2	27.3	71.6	74.3	84.	51.9
85	6/20-27/32	72.1	41.7	66.6	72.1	82.8	44.
"	6/27-7/4/32	69.8	32.2	66.3	69.1	80.4	44.7
Average		72.4	38.5	71.	73.3	81.6	46.4

TABLE 6.—COEFFICIENTS OF DIGESTIBILITY OBTAINED IN TRIAL I ON RATION OF GREEN GRASS

Cow	Date	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract
24	7/13-20/31	71.3	40.8	76.4	73.9	77.8	35.5
"	7/20-27/31	73.1	45.2	79.7	75.6	78.7	46.4
50	6/22-29/31	70.4	44.4	77.3	69.7	74.7	45.7
"	6/29-7/6/31	69.1	37.9	74.5	74.5	74.7	34.5
83	6/20-27/32	73.1	29.5	77.2	77.9	81.4	39.3
"	6/27-7/4/32	71.8	38.5	74.8	76.1	78.8	42.9
85	7/11-18/32	68.7	18.4	76.	73.9	78.1	34.2
"	7/18-25/32	70.3	31.5	75.9	73.6	79.2	41.5
Average		71.	35.8	76.5	74.4	77.9	40.

free extract vary but slightly from 1.1 points (crude fiber) to 3.7 (nitrogen free extract). Somewhat greater differences occur in the digestibilities of the crude protein and ether extract. The crude protein in the green grass is 5.5 points, or 7.7 percent, more digestible than that in the dried grass and the ether extract in the dried grass 6.4 points, or 16 percent, more digestible than that in the green material. Furthermore, the coefficients of digestibility obtained with each of the four cows were found to be in close agreement whether they were fed dried or green grass.

Applying the average coefficients of digestibility obtained in this trial (tables 5 and 6) to the average compositions of the dried and of the green grass (tables 1 and 2), it appears that the total digestible nutrients in the dried grass as fed were 64.37 percent and in the green grass as fed 17.36 percent. Calculating the green grass on the same dry matter basis as the dried grass (90.17 percent) the amount of total digestible nutrients would be 63.36 percent which agrees very closely with that of the dried grass.

The following table shows the coefficients of digestibility of artificially dried grass and freshly cut grass as obtained in England by Watson (1) and Woodman et al. (2) in trials with sheep.

TABLE 7.—DIGESTIBILITY COEFFICIENTS OF ARTIFICIALLY DRIED GRASS AND FRESHLY CUT GRASS

	Dried grass (Watson)	Dried grass (Watson)	Dried grass cake (Woodman et al.)	Kiln-dried grass (Woodman et al.)	Freshly cut grass (Woodman et al)
Crude protein.....	76.4	67.1	78.2	78.2	81.5
Crude fiber.....	59.6	77.6	70.6	73.7	57.2
Nitrogen free extract.....	76.9	74.3	79.3	80.4	80.3
Ether extract.....	79.1	51.1	78.3	81.	80.2

Except for the fat these results secured with sheep are in general agreement with those obtained here with dairy cows. All but one of the English figures for fat indicate a high degree of digestibility for this nutrient, while the Vermont results in both the dried and green grass are low.

If calculated to the same dry matter basis as in the Vermont trials (90.17 percent) Watson (1) found the total digestible nutrients of dried grass, averaging two trials, to be 63.81 percent, while Woodman et al. (3) found the total digestible nutrients of weekly cut grass to be 67.28 percent. These results compare closely with those secured at this Station.

TABLE 8.—COMPOSITION OF FECES (TRIAL I BY WEEKS)

Cow	Period	Date	Water		Dry matter		Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract	Calcium	Phosphorus
			percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent
24	1	6/22-29/31	86.07	13.93	2.48	3.07	2.59	4.85	0.94	0.262	0.166		
"	"	6/29-7/5	83.86	16.14	3.47	3.52	2.72	5.07	1.36	0.409	0.257		
"	2	7/12-19	86.31	13.69	2.70	2.49	2.50	4.60	1.40	0.310	0.196		
"	"	7/19-26	85.61	14.39	3.10	2.63	2.54	4.61	1.51	0.409	0.266		
50	1	6/22-29	86.30	13.70	2.36	2.49	2.63	5.15	1.07	0.234	0.143		
"	"	6/29-7/5	84.97	15.03	3.22	2.73	2.54	5.26	1.28	0.313	0.186		
"	2	7/12-19	85.41	14.59	2.40	3.63	2.81	4.49	1.26	0.290	0.162		
"	"	7/19-26	85.16	14.84	2.86	3.31	2.75	4.44	1.48	0.358	0.230		
83	1	6/20-27/32	88.45	11.55	3.04	2.21	1.83	3.54	0.93	0.199	0.130		
"	"	6/27-7/4	87.59	12.41	2.85	2.40	1.96	4.21	0.99	0.231	0.121		
"	2	7/11-18	89.06	10.94	2.32	2.55	1.93	3.34	0.80	0.193	0.137		
"	"	7/18-25	87.17	12.83	3.02	3.06	2.27	3.55	0.93	0.244	0.138		
85	1	6/20-27	89.14	10.86	1.99	2.90	2.11	3.07	0.79	0.159	0.124		
"	"	6/27-7/4	88.76	11.24	2.15	2.68	2.04	3.53	0.84	0.204	0.103		
"	2	7/11-18	90.05	9.95	2.76	1.80	1.65	2.94	0.81	0.169	0.132		
"	"	7/18-25	89.96	10.04	2.63	1.93	1.69	2.95	0.84	0.182	0.121		

TRIAL II—DIGESTIBILITY OF A RATION OF TIMOTHY HAY, CORN SILAGE AND DRIED YOUNG GRASS AND OF A RATION OF TIMOTHY HAY, CORN SILAGE AND A GRAIN MIXTURE

The second trial carried on during the winter of 1931-32 compared the digestibility of a ration composed of timothy hay, corn silage and dried young grass with that of a ration composed of timothy hay, corn silage and grain.

Two registered Ayrshires (Nos. 23, 50) and two registered Jerseys (Nos. 55, 56) were used. The three collection periods were two weeks long as were also the adjustment periods. The first period of the trial with the Jerseys was extended to three weeks because cow 55 went slightly off feed during the second week.

The initial and final daily milk yields ranged about as follows: No. 23, 38 to 28 pounds; No. 50, 20 to 12.5 pounds; No. 55, 29 to 19 pounds; No. 56, 19 to 14 pounds. The initial and final live weights were: No. 23, 1,085 and 1,069 pounds; No. 50, 1,045 and 1,035 pounds; No. 55, 857 and 781 pounds; No. 56, 905 and 838 pounds; the Ayrshires losing one percent, the Jerseys eight percent in live weight.

The Haecker standard was used in computing the rations, the general rule of feeding a pound of hay and three pounds of silage per hundredweight being followed as closely as practicable, the additional requirements being supplied with either dried grass or grain.

COMPOSITION

The composition of the two rations as fed is given by weekly periods in tables 9 and 10. It will be noted that the percentages of the different nutrients of each ration run fairly uniform throughout the

TABLE 9.—COMPOSITION OF RATION (HAY, SILAGE AND DRIED GRASS AS FED)

Cow	Period	Date	Water	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract	Calcium	Phosphorus
			percent	percent	percent	percent	percent	percent	percent	percent	percent
23	2	11/12-19/31	50.05	49.95	3.61	7.09	13.30	24.42	1.53	0.234	0.171
"	"	11/19-26	50.74	49.26	3.64	6.98	13.03	24.11	1.50	0.236	0.168
50	1	10/15-22	53.27	46.73	3.18	5.84	12.78	23.63	1.30	0.212	0.144
"	"	10/22-29	53.70	46.30	3.10	5.91	12.65	23.36	1.28	0.215	0.148
"	3	12/17-24	52.90	47.10	3.17	5.45	13.22	23.99	1.27	0.207	0.128
"	"	12/24-31	53.77	46.23	3.03	5.24	13.04	23.71	1.21	0.193	0.130
55	2	1/7-14/32	50.91	49.09	3.27	6.23	13.38	24.93	1.28	0.220	0.144
"	"	1/14-21	52.27	47.73	3.28	6.43	13.07	23.67	1.28	0.220	0.144
56	1	11/26-12/3/31	51.37	48.63	3.35	6.41	12.98	24.45	1.44	0.229	0.150
"	"	12/3-10	51.21	48.79	3.32	5.95	13.31	24.83	1.38	0.217	0.143
"	"	12/10-17	51.89	48.11	3.27	5.94	13.36	24.21	1.33	0.216	0.143
"	3	2/4-11/32	53.75	46.25	2.98	5.50	12.90	23.57	1.30	0.207	0.135
"	"	2/11-18	53.82	46.18	3.03	5.60	12.90	23.37	1.28	0.208	0.135
Average			52.28	47.72	3.25	6.04	13.07	24.02	1.34	0.216	0.145

TABLE 10.—COMPOSITION OF RATION (HAY, SILAGE AND GRAIN AS FED)

Cow	Period	Date	Water	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract	Calcium	Phosphorus
			percent	percent	percent	percent	percent	percent	percent	percent	percent
23	1	10/15-22/31	51.09	48.91	2.59	7.05	10.43	27.23	1.61	0.130	0.218
"	"	10/22-29	50.97	49.03	2.53	7.14	10.57	27.04	1.75	0.133	0.224
"	3	12/17-24	49.30	50.70	2.68	7.36	10.99	28.	1.67	0.147	0.214
"	"	12/24-31	49.95	50.05	2.62	7.22	10.83	27.73	1.65	0.136	0.218
50	2	11/12-19	54.80	45.20	2.54	5.60	11.41	24.25	1.40	0.126	0.173
"	"	11/19-26	54.29	45.71	2.55	5.72	11.44	24.58	1.42	0.137	0.174
55	1	11/26-12/3	49.13	50.87	2.70	7.51	10.55	28.25	1.86	0.144	0.229
"	"	12/3-10	52.09	47.91	2.61	6.46	10.61	26.60	1.63	0.135	0.196
"	"	12/10-17	54.94	45.06	2.41	5.74	10.82	24.73	1.36	0.128	0.171
"	3	2/4-11/32	52.18	47.82	2.45	6.42	11.26	26.19	1.50	0.145	0.186
"	"	2/11-18	52.53	47.47	2.45	6.41	11.24	26.03	1.44	0.142	0.184
56	2	1/7-14	53.96	46.04	2.39	5.23	11.81	25.37	1.24	0.125	0.160
"	"	1/14-21	54.78	45.22	2.42	5.52	11.77	24.26	1.25	0.127	0.161
Average			52.31	47.69	2.53	6.41	11.06	26.17	1.52	0.135	0.193

entire trial. The average dry matter contents were practically the same in both cases, those of crude protein, nitrogen free extract and ether extract a little lower and of ash and crude fiber, somewhat higher in the dried grass ration than in the grain ration.

TABLE 11.—DIGESTIBILITY OF A RATION OF HAY, SILAGE AND DRIED GRASS VERSUS A RATION OF HAY, SILAGE AND GRAIN

Trial II	Period 1 Grain ration						Period 2 Dried grass ration						Period 3 Grain ration						
	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract	
Cow	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams
No. 23	First week 10/15-22/31						First week 11/12-19/31						First week 12/17-24/31						
Nutrients consumed	87,063	4,611	12,545	18,562	48,477	2,868	82,475	5,965	11,709	21,958	40,318	2,525	83,713	4,419	12,152	18,157	46,223	2,762	
Excrement	30,913	3,069	4,341	8,967	13,780	756	31,746	4,190	4,932	8,643	12,793	1,188	28,806	2,924	3,881	8,913	12,538	550	
Nutrients digested	56,150	1,542	8,204	9,595	34,697	2,112	50,729	1,775	6,777	13,315	27,525	1,337	54,907	1,495	8,271	9,244	33,685	2,212	
Coefficients of digestibility	64.5	33.4	65.4	51.7	71.6	73.6	61.5	29.8	57.9	60.6	68.3	53.	65.6	33.8	68.1	50.9	72.9	80.1	
	Second week 10/22-29/31						Second week 11/19-26/31						Second week 12/24-31/31						
Nutrients consumed	87,262	4,501	12,704	18,817	48,127	3,113	78,896	5,829	11,170	20,872	38,619	2,406	82,627	4,317	11,926	17,874	45,783	2,727	
Excrement	31,320	2,954	4,332	9,692	13,614	728	29,183	3,807	4,603	7,997	11,688	1,088	28,645	2,718	3,867	8,860	12,674	526	
Nutrients digested	55,942	1,547	8,372	9,125	34,513	2,385	49,713	2,022	6,567	12,875	26,931	1,318	53,982	1,599	8,059	9,014	33,109	2,201	
Coefficients of digestibility	64.1	34.4	65.9	48.5	71.7	76.6	63.	34.7	58.8	61.7	69.7	54.8	65.3	37.	67.6	50.4	72.3	80.7	
	Dried grass ration						Grain ration						Dried grass ration						
No. 50	First week 10/15-22/31						First week 11/12-19/31						First week 12/17-24/31						
Nutrients consumed	71,234	4,855	8,893	19,487	36,022	1,977	67,428	3,787	8,356	17,014	36,184	2,087	65,800	4,429	7,612	18,473	33,512	1,774	
Excrement	26,758	3,124	3,734	7,638	11,249	1,013	25,560	2,883	3,057	7,626	11,540	454	24,932	2,608	3,158	7,334	11,017	815	
Nutrients digested	44,476	1,731	5,159	11,849	24,773	964	41,868	904	5,299	9,388	24,644	1,633	40,868	1,821	4,454	11,139	22,495	959	
Coefficients of digestibility	62.4	35.7	58.	60.8	68.8	48.8	62.1	23.9	63.4	55.2	68.1	78.2	62.1	41.1	58.5	60.3	67.1	54.1	
	Second week 10/22-29/31						Second week 11/19-26/31						Second week 12/24-31/31						
Nutrients consumed	69,518	4,653	8,873	19,004	35,067	1,921	68,110	3,806	8,515	17,046	36,630	2,113	64,591	4,233	7,319	18,217	33,125	1,697	
Excrement	22,138	2,569	3,624	6,241	8,847	857	24,747	2,841	3,035	7,572	10,842	457	24,553	2,709	3,133	7,359	10,625	727	
Nutrients digested	47,380	2,084	5,249	12,763	26,220	1,064	43,363	965	5,480	9,474	25,788	1,656	40,038	1,524	4,186	10,858	22,500	970	
Coefficients of digestibility	68.2	44.8	59.2	67.2	74.8	55.4	63.7	25.3	64.4	55.6	70.4	78.4	62.	36.	57.2	59.6	67.9	57.2	

TABLE 12.—DIGESTIBILITY OF A RATION OF HAY, SILAGE AND DRIED GRASS VERSUS A RATION OF HAY, SILAGE AND GRAIN

Trial II	Period 1 Grain ration						Period 2 Dried grass ration						Period 3 Grain ration					
	Dry matter		Crude protein	Crude fiber	Nitrogen free extract	Ether extract	Dry matter		Crude protein	Crude fiber	Nitrogen free extract	Ether extract	Dry matter		Crude protein	Crude fiber	Nitrogen free extract	Ether extract
	grams	grams					grams	grams					grams	grams				
No. 55	First week 11/26-12/3/31						First week 1/7-14/32						First week 2/4-11/32					
Nutrients consumed	66,814	3,548	9,867	13,849	37,103	2,447	63,910	4,254	8,108	17,418	32,458	1,672	60,720	3,110	8,155	14,296	33,259	1,900
Excrement	24,820	2,787	3,539	7,286	10,709	499	24,153	2,784	3,393	6,894	10,240	842	22,153	2,336	3,007	7,144	9,317	349
Nutrients digested	41,994	761	6,328	6,563	26,394	1,948	39,757	1,470	4,715	10,524	22,218	830	38,567	774	5,148	7,152	23,942	1,551
Coefficients of digestibility	62.8	21.4	64.1	47.4	71.1	79.6	62.2	34.6	58.2	60.4	68.4	49.7	63.5	24.9	63.1	50.	72.	81.6
	Second week 12/3-10/31						Second week 1/14-21/32						Second week 2/11-18/32					
Nutrients consumed	60,856	3,313	8,207	13,473	33,786	2,077	61,086	4,195	8,226	16,725	30,294	1,646	60,266	3,110	8,143	14,266	32,923	1,824
Excrement	24,461	2,441	3,501	7,394	10,678	447	23,537	2,767	3,464	6,699	9,875	732	22,688	2,362	3,064	7,270	9,637	355
Nutrients digested	36,395	872	4,706	6,079	23,108	1,630	37,549	1,428	4,762	10,026	20,419	914	37,578	748	5,079	6,996	23,286	1,469
Coefficients of digestibility	59.8	26.3	57.3	45.1	68.4	78.5	61.5	34.	57.9	59.9	67.4	55.5	62.4	24.	62.4	49.	70.7	80.5
	Third week 12/10-17/31																	
Nutrients consumed	60,193	3,217	7,663	14,463	33,034	1,816												
Excrement	22,144	2,209	2,947	7,175	9,470	343												
Nutrients digested	38,049	1,008	4,716	7,288	23,564	1,473												
Coefficients of digestibility	63.2	31.3	61.5	50.4	71.3	81.1												
	Dried grass ration						Grain ration						Dried grass ration					
No. 56	First week 11/26-12/3/31						First week 1/7-14/32						First week 2/4-11/32					
Nutrients consumed	61,967	4,274	8,174	16,538	31,151	1,830	55,560	2,884	6,316	14,253	30,614	1,493	56,825	3,667	6,755	15,847	28,964	1,592
Excrement	22,722	2,566	3,415	6,063	9,733	945	21,538	2,134	2,583	6,544	9,873	404	22,101	2,511	3,018	6,520	9,417	635
Nutrients digested	39,245	1,708	4,759	10,475	21,418	885	34,022	750	3,733	7,709	20,741	1,089	34,724	1,156	3,737	9,327	19,547	957
Coefficients of digestibility	63.3	39.9	58.2	63.3	68.8	48.4	61.2	26.	59.1	54.1	67.8	73.	61.1	31.5	55.3	58.9	67.5	60.1
	Second week 12/3-10/31						Second week 1/14-21/32						Second week 2/11-18/32					
Nutrients consumed	61,350	4,170	7,477	16,740	31,223	1,740	54,526	2,919	6,654	14,197	29,251	1,505	57,197	3,746	6,935	15,980	28,949	1,587
Excrement	23,075	2,526	3,271	6,581	9,912	785	20,473	2,027	2,476	6,525	9,098	347	21,682	2,419	2,916	6,466	9,255	626
Nutrients digested	38,275	1,644	4,206	10,159	21,311	955	34,053	892	4,178	7,672	20,153	1,158	35,515	1,327	4,019	9,514	19,694	961
Coefficients of digestibility	62.4	39.4	56.2	60.7	68.3	54.9	62.5	30.5	62.8	54.	68.9	77.	62.1	35.4	57.9	59.5	68.	60.6
	Third week 12/10-17/31																	
Nutrients consumed	61,038	4,154	7,533	16,949	30,712	1,690												
Excrement	22,318	2,617	2,889	6,401	9,723	688												
Nutrients digested	38,720	1,537	4,644	10,548	20,989	1,002												
Coefficients of digestibility	63.4	37.	61.6	62.2	68.3	59.3												

TABLE 13.—COEFFICIENTS OF DIGESTIBILITY OBTAINED IN TRIAL II ON RATION OF HAY, SILAGE AND DRIED GRASS

Cow	Date	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract
23	11/12-19/31	61.5	29.8	57.9	60.6	68.3	53.
"	11/19-26	63.	34.7	58.8	61.7	69.7	54.8
50	10/15-22	62.4	35.7	58.	60.8	68.8	48.8
"	10/22-29	68.2	44.8	59.2	67.2	74.8	55.4
"	12/17-24	62.1	41.1	58.5	60.3	67.1	54.1
"	12/24-31	62.	36.	57.2	59.6	67.9	57.2
55	1/7-14/32	62.2	34.6	58.2	60.4	68.4	49.7
"	1/14-21	61.5	34.	57.9	59.9	67.4	55.5
56	11/26-12/3/31	63.3	39.9	58.2	63.3	68.8	48.4
"	12/3-10	62.4	39.4	56.2	60.7	68.3	54.9
"	12/10-17	63.4	37.	61.6	62.2	68.3	59.3
"	2/4-11/32	61.1	31.5	55.3	58.9	67.8	60.1
"	2/11-18	62.1	35.4	57.9	59.5	68.	60.6
Average		62.7	36.5	58.1	61.2	68.7	54.8

TABLE 14.—COEFFICIENTS OF DIGESTIBILITY OBTAINED IN TRIAL II ON RATION OF HAY, SILAGE AND GRAIN

Cow	Date	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract
23	10/15-22/31	64.5	33.4	65.4	51.7	71.6	73.6
"	10/22-29	64.1	34.4	65.9	48.5	71.7	76.6
"	12/17-24	65.6	33.8	68.1	50.9	72.9	80.1
"	12/24-31	65.3	37.	67.6	50.4	72.3	80.7
50	11/12-19	62.1	23.9	63.4	55.2	68.1	78.2
"	11/19-26	63.7	25.3	64.4	55.6	70.4	78.4
55	11/26-12/3	62.8	21.4	64.1	47.4	71.1	79.6
"	12/3-10	59.8	26.3	57.3	45.1	68.4	78.5
"	12/10-17	63.2	31.3	61.5	50.4	71.3	81.1
"	2/4-11/32	63.5	24.9	63.1	50.	72.	81.6
"	2/11-18	62.4	24.	62.4	49.	70.7	80.5
56	1/7-14	61.2	26.	59.1	54.1	67.8	73.
"	1/14-21	62.5	30.5	62.8	54.	68.9	77.
Average		63.1	28.6	63.5	51.	70.6	78.4

RESULTS

The amounts of the different nutrients eaten, voided and digested weekly by each cow are shown in tables 11 and 12, as well as the coefficients of digestibility obtained when the cows received dried grass in the ration and when they received grain in place of the dried grass. In order to facilitate comparison the coefficients are listed separately in tables 13 and 14. It will be noted that the coefficients of digestibility of the dry matter are practically the same in both rations, 62.7, 63.1. The coefficients for ash were higher in every case except one for the dried grass ration than for the grain ration, the averages being 36.5 and 28.6; and for crude protein lower in every case except one, the averages being 58.1 and 63.5; for crude fiber always higher, the averages being 61.2 and 51; for nitrogen free extract slightly lower in 11 cases, equal in one and greater in one, the averages being 68.7 and 70.6; for ether extract always lower, the averages being 54.8 and 78.4. The

greatest divergencies occur with crude fiber and ether extract. The crude fiber of the grain ration was 10.2 points, or 16.7 percent, less digestible than that in the dried grass ration, while on the other hand, the fat in the dried grass ration was 23.6 points, or 30.1 percent, less digestible than that in the grain ration. (Table 15.)

TABLE 15.—COMPOSITION OF FEEDS (RECALCULATED BY WEEKS)

Cow	Period	Date	Water	Dry matter	Ash	Crude protein	Crude fiber	Nitrogen free extract	Ether extract	Calcium	Phosphorus
			per- cent	per- cent	per- cent	per- cent	per- cent	per- cent	per- cent	per- cent	per- cent
23	1	10/15-22/31	84.59	15.41	1.53	2.16	4.47	6.87	0.38	0.068	0.128
"	"	10/22-29	84.52	15.48	1.46	2.14	4.79	6.73	0.36	0.069	0.130
"	2	11/12-19	84.39	15.61	2.06	2.43	4.25	6.29	0.58	0.137	0.096
"	"	11/19-26	83.98	16.02	2.09	2.53	4.39	6.41	0.60	0.149	0.097
"	3	12/17-24	83.55	16.45	1.67	2.22	5.09	7.16	0.31	0.078	0.122
"	"	12/24-31	83.77	16.23	1.54	2.19	5.02	7.18	0.30	0.069	0.127
50	1	10/15-22	85.18	14.82	1.73	2.07	4.23	6.23	0.56	0.151	0.099
"	"	10/22-29	87.16	12.84	1.49	2.10	3.62	5.13	0.50	0.128	0.086
"	2	11/12-19	84.75	15.25	1.72	1.82	4.55	6.89	0.27	0.095	0.134
"	"	11/19-26	84.41	15.59	1.79	1.91	4.77	6.83	0.29	0.102	0.130
"	3	12/17-24	83.75	16.25	1.70	2.06	4.78	7.18	0.53	0.140	0.081
"	"	12/24-31	83.05	16.95	1.87	2.16	5.08	7.34	0.50	0.141	0.097
55	1	11/26-12/3	85.93	14.07	1.61	2.01	4.13	6.04	0.28	0.063	0.134
"	"	12/3-10	86.37	13.63	1.36	1.95	4.12	5.95	0.25	0.068	0.124
"	"	12/10-17	87.07	12.93	1.29	1.72	4.19	5.53	0.20	0.065	0.109
"	2	1/7-14/32	85.25	14.75	1.70	2.07	4.21	6.26	0.51	0.132	0.082
"	"	1/14-21	87.07	12.93	1.52	1.90	3.68	5.43	0.40	0.110	0.071
"	3	2/4-11	87.10	12.90	1.36	1.75	4.16	5.43	0.20	0.079	0.106
"	"	2/11-18	87.61	12.39	1.29	1.67	3.97	5.26	0.20	0.068	0.101
56	1	11/26-12/3/31	85.57	14.43	1.63	2.17	3.85	6.18	0.60	0.148	0.103
"	"	12/3-10	85.66	14.34	1.57	2.03	4.09	6.16	0.49	0.124	0.083
"	"	12/10-17	85.67	14.33	1.68	1.86	4.11	6.24	0.44	0.131	0.090
"	2	1/7-14/32	84.96	15.04	1.49	1.80	4.57	6.90	0.28	0.103	0.119
"	"	1/14-21	85.66	14.34	1.42	1.73	4.57	6.38	0.24	0.088	0.113
"	3	2/4-11	85.39	14.61	1.66	2.00	4.31	6.22	0.42	0.152	0.091
"	"	2/11-18	85.48	14.52	1.62	1.95	4.33	6.20	0.42	0.141	0.089

CALCIUM AND PHOSPHORUS BALANCES

Calcium and phosphorus balances for each cow on trial were determined in connection with the digestion experiments. Obviously the results of short time mineral balance trials are not as illuminating as are those of long time trials extending through complete lactation and gestation periods such as have been already reported by this Station (4), but they were obtained in order to note what differences, if any, could be observed which conceivably might be ascribed to the different types of feed used.

RESULTS

Tables 16 and 17 set forth the results secured in trial I wherein the rations consisted solely of either dried grass or green grass. Four cows were used and eight weekly balances with each of the rations

TABLE 16.—WEEKLY BALANCE OF CALCIUM AND PHOSPHORUS (TRIAL 1)

Date	Intake and outgo	Calcium Phosphorus		Intake and outgo	Calcium Phosphorus	
		Cow 24			Cow 50	
		grams	grams	grams	grams	
6/22-29/31	Dried grass..	321.98	188.65	Green grass..	427.64	259.70
	Milk	4.84	3.20	Milk	71.16	56.85
	Urine	20.82	9.20	Urine	23.77	1.88
	Feces	218.50	138.40	Feces	292.25	178.10
	Total	244.16	150.80	Total	387.18	236.83
	Balance	+77.82	+37.85	Balance	+40.46	+22.87
6/29-7/5/31	Dried grass..	352.76	189.40	Green grass..	461.56	259.20
	Milk	0.27	0.20	Milk	61.91	50.16
	Urine	14.29	8.46	Urine	12.52	4.46
	Feces	292.56	184.09	Feces	365.10	216.80
	Total	307.12	192.75	Total	439.53	271.42
	Balance	+45.64	-3.35	Balance	+22.03	-12.22
7/13-19/31	Green grass..	347.97	208.	Dried grass..	383.70	247.25
	Milk .....	.....	.....	Milk	59.39	48.35
	Urine	22.23	2.19	Urine	8.31	1.56
	Feces	290.50	184.	Feces	263.09	147.04
	Total	312.73	186.19	Total	330.79	196.95
	Balance	+35.24	+21.81	Balance	+52.91	+50.30
7/19-26/31	Green grass..	387.28	248.15	Dried grass..	442.61	294.40
	Milk .....	.....	.....	Milk	53.56	44.
	Urine	14.31	2.84	Urine	12.33	1.30
	Feces	339.50	220.90	Feces	367.53	236.35
	Total	353.81	223.74	Total	433.42	281.65
	Balance	+33.47	+24.41	Balance	+9.19	+12.75
		Cow 83			Cow 85	
6/20-27/32	Green grass..	396.76	259.60	Dried grass..	391.99	273.07
	Milk	41.43	30.95	Milk	56.96	40.31
	Urine	32.11	35.04	Urine	25.32	3.77
	Feces	248.15	162.69	Feces	245.02	191.48
	Total	321.69	228.68	Total	327.30	235.56
	Balance	+75.07	+30.92	Balance	+64.69	+37.51
6/27-7/4/32	Green grass..	426.49	212.09	Dried grass..	470.04	244.36
	Milk	30.92	20.99	Milk	45.51	30.18
	Urine	49.48	15.69	Urine	31.35	2.25
	Feces	258.59	135.90	Feces	319.94	162.25
	Total	338.99	172.58	Total	396.80	194.68
	Balance	+87.50	+39.51	Balance	+73.24	+49.68
7/11-18/32	Dried grass..	420.35	301.20	Green grass..	356.36	243.55
	Milk	19.19	12.33	Milk	12.13	6.86
	Urine	27.40	12.35	Urine	28.38	2.53
	Feces	326.61	232.66	Feces	250.61	195.23
	Total	373.20	257.34	Total	291.12	204.62
	Balance	+47.15	+43.86	Balance	+65.24	+38.93
7/18-25/32	Dried grass..	402.90	222.65	Green grass..	321.66	178.91
	Milk .....	.....	.....	Milk .....	.....	.....
	Urine	29.80	10.26	Urine	34.03	2.73
	Feces	294.32	166.30	Feces	230.62	153.11
	Total	324.12	176.56	Total	264.65	155.84
	Balance	+78.78	+46.09	Balance	+57.01	+23.07

were obtained. Details are given in the former and a summary in the latter table. The mineral balances were all positive except that in two cases a negative balance of phosphorus was found. The average amounts of mineral ingested per week in the two rations are nearly equal (table 17)—398 and 391 grams calcium, 247 and 234 grams phosphorus. The milk yields, though small, are also nearly identical. These two factors being practically the same, it might be assumed that the averages of the mineral balances would show a similarity if the minerals in the two rations were equally available. This assumption holds for calcium, the balances being nearly the same in both cases. The phosphorus balances, however, show greater differences, that of the green grass ration being only two-thirds as large—69 percent—as that of the dried grass ration. It must be remembered, however, that these averages are based on trials lasting for only eight weeks, which is altogether too short a period to warrant generalization.

TABLE 17.—SUMMARY SHOWING RELATIONSHIP OF MINERAL BALANCES TO MINERALS IN RATION AND MILK YIELDS BY WEEKLY PERIODS

Cow	Ration of dried grass					Ration of green grass				
	Minerals in ration		Milk yield	Mineral balances		Minerals in ration		Milk yield	Mineral balances	
	Calcium	Phosphorus		Calcium	Phosphorus	Calcium	Phosphorus		Calcium	Phosphorus
	grams	grams	kilo-grams	grams	grams	grams	grams	kilo-grams	grams	grams
24	322	189	3.3	+77.8	+37.9	348	208	...	+35.2	+21.8
	353	189	0.2	+45.6	-3.4	387	248	...	+33.5	+24.4
50	384	247	46.4	+52.9	+50.3	428	260	58.3	+40.5	+22.9
	443	294	44.6	+9.2	+12.8	462	259	51.2	+22.	-12.2
83	420	301	12.8	+47.2	+43.9	397	260	31.4	+75.1	+30.9
	403	223	...	+78.8	+46.1	426	212	21.8	+87.5	+39.5
85	392	289	39.6	+64.7	+37.5	356	244	6.1	+65.2	+38.9
	470	244	29.9	+73.2	+49.7	322	179	...	+57.	+23.1
Average	398	247	22.1	+56.2	+34.4	391	234	21.1	+52.	+23.7
Ratio Calcium: Phosphorus						1.67: 1				
	1.61: 1									

Tables 18 and 19 set forth the results secured in trial II wherein the rations fed consisted either of timothy hay, silage and dried grass or timothy hay, silage and grain. Thirteen balances of calcium and phosphorus using four cows were obtained with each ration. The figures summarized in table 19 show that on the dried grass ration the four cows exhibited 10 negative and three positive balances of both

TABLE 18.—WEEKLY BALANCE OF CALCIUM AND PHOSPHORUS (TRIAL II)

Date	Intake and outgo	Cow 23		Intake and outgo	Cow 50	
		Calcium	Phosphorus		Calcium	Phosphorus
		grams	grams		grams	grams
10/15-22/31	Timothy hay	93.03	45.98	Timothy hay.	93.03	45.98
	Silage	62.66	62.87	Silage	56.96	57.28
	Grain	84.42	279.79	Dried grass..	177.06	115.66
	Total	240.11	388.64	Total	327.05	218.92
	Milk	139.73	102.47	Milk	75.20	60.13
	Urine	9.52	30.34	Urine	1.72	1.66
	Feces	136.41	257.38	Feces	272.28	178.39
	Total	285.66	390.19	Total	349.20	240.18
	Balance	-45.55	-1.55	Balance	-22.15	-21.26
10/22-29/31	Timothy hay	93.03	45.98	Timothy hay.	86.39	42.69
	Silage	69.37	70.83	Silage	63.09	64.39
	Grain	82.98	281.68	Dried grass..	176.86	115.66
	Total	245.38	398.49	Total	326.34	222.74
	Milk	133.31	91.08	Milk	79.70	61.07
	Urine	9.79	51.	Urine	0.56	2.
	Feces	139.61	262.21	Feces	220.52	148.79
	Total	282.71	404.29	Total	300.78	211.86
	Balance	-37.33	-5.80	Balance	+25.56	+10.88
11/12-19/31	Timothy hay	89.35	51.18	Timothy hay.	89.35	51.18
	Silage	59.06	57.28	Silage	59.06	57.28
	Dried grass.	244.89	174.66	Grain	43.59	149.68
	Total	393.30	283.12	Total	192.	258.14
	Milk	120.95	86.26	Milk	67.51	52.65
	Urine	9.91	2.26	Urine	0.22	1.57
	Feces	277.81	195.24	Feces	159.90	224.26
	Total	408.67	283.76	Total	227.63	278.48
	Balance	-15.37	-0.64	Balance	-35.63	-20.34
11/19-26/31	Timothy hay	82.97	47.53	Timothy hay.	88.78	50.86
	Silage	74.64	58.87	Silage	74.68	58.87
	Dried grass.	227.93	162.19	Grain	43.70	149.68
	Total	385.54	268.59	Total	207.16	259.41
	Milk	121.25	88.01	Milk	62.16	49.19
	Urine	4.49	1.84	Urine	1.90	0.90
	Feces	270.52	176.15	Feces	161.59	205.72
	Total	396.26	266.	Total	225.65	255.81
	Balance	-10.72	+2.59	Balance	-18.49	+3.60
12/17-24/31	Timothy hay	94.59	36.26	Timothy hay.	94.59	36.26
	Silage	76.87	59.92	Silage	71.78	55.94
	Grain	78.18	256.99	Dried grass..	126.93	86.36
	Total	249.64	353.17	Total	293.30	178.56
	Milk	120.09	80.27	Milk	55.09	39.26
	Urine	9.45	55.91	Urine	3.62	0.92
	Feces	135.89	213.99	Feces	214.50	124.12
	Total	265.43	350.17	Total	273.21	164.30
	Balance	-15.79	+3.	Balance	+20.09	+14.26
12/24-31/31	Timothy hay	92.75	41.09	Timothy hay.	92.75	41.09
	Silage	61.15	61.15	Silage	57.08	57.08
	Grain	78.07	256.99	Dried grass..	122.94	83.41
	Total	231.97	359.23	Total	272.77	181.58
	Milk	117.16	73.19	Milk	54.93	40.88
	Urine	9.91	50.64	Urine	1.46	1.65
	Feces	122.14	224.68	Feces	204.25	140.37
	Total	249.21	348.51	Total	260.64	182.90
	Balance	-17.24	+10.72	Balance	+12.13	-1.32

TABLE 18.—WEEKLY BALANCE OF CALCIUM AND PHOSPHORUS (TRIAL II)—*Concluded*

Date	Intake and outgo	Calcium		Phosphorus		Intake and outgo	Calcium		Phosphorus	
		Cow 55					Cow 56			
		grams	grams			grams	grams			
11/26-12/3/31	Timothy hay	77.25	30.54			Timothy hay.	83.69	33.09		
	Silage	52.32	44.97			Silage	53.50	46.64		
	Grain	64.48	224.64			Dried grass..	160.01	111.73		
	Total	194.05	300.15			Total	297.20	191.46		
	Milk	116.34	83.76			Milk	90.03	61.01		
Urine	5.72	1.03			Urine	0.59	0.95			
Feces	111.14	237.09			Feces	232.58	161.88			
Total	233.20	321.88			Total	323.20	223.84			
Balance	-39.15	-21.73			Balance	-26.	-32.38			
12/3-10/31	Timothy hay	74.11	29.30			Timothy hay.	90.13	35.64		
	Silage	52.27	50.08			Silage	50.92	48.77		
	Grain	50.96	168.93			Dried grass..	135.93	94.89		
	Total	177.34	248.31			Total	276.98	179.30		
	Milk	115.48	88.94			Milk	89.84	59.58		
Urine	4.43	0.70			Urine	0.59	0.57			
Feces	121.32	222.54			Feces	200.18	133.24			
Total	241.23	312.18			Total	290.61	193.39			
Balance	-63.89	-63.87			Balance	-13.63	-14.09			
12/10-17/31	Timothy hay	73.03	33.44			Timothy hay.	78.64	36.01		
	Silage	58.97	50.97			Silage	52.43	45.30		
	Grain	44.61	143.86			Dried grass..	146.11	100.03		
	Total	176.61	228.27			Total	277.18	181.34		
	Milk	100.59	75.23			Milk	82.22	49.03		
Urine	5.84	0.65			Urine	0.14	0.70			
Feces	110.80	186.50			Feces	203.71	139.55			
Total	217.23	262.38			Total	286.07	189.28			
Balance	-40.62	-34.11			Balance	-8.89	-7.94			
1/7-14/32	Timothy hay	73.56	38.15			Timothy hay.	73.56	38.15		
	Silage	48.16	47.38			Silage	48.19	47.40		
	Dried grass.	170.51	101.30			Grain	32.86	107.91		
	Total	292.23	186.83			Total	154.61	193.46		
	Milk	90.20	69.			Milk	77.50	55.50		
Urine	7.38	0.91			Urine	0.74	0.68			
Feces	216.64	133.62			Feces	146.78	169.98			
Total	314.22	203.53			Total	225.02	226.16			
Balance	-21.99	-16.70			Balance	-70.41	-32.70			
1/14-21/32	Timothy hay	72.87	38.44			Timothy hay.	78.43	41.38		
	Silage	45.22	44.73			Silage	45.22	44.73		
	Dried grass.	169.60	100.90			Grain	32.54	107.91		
	Total	287.69	184.07			Total	156.19	194.02		
	Milk	90.86	61.01			Milk	70.62	48.17		
Urine	4.09	1.21			Urine	0.92	1.19			
Feces	199.87	129.61			Feces	125.35	161.47			
Total	294.82	191.83			Total	196.89	210.83			
Balance	-7.13	-7.76			Balance	-40.70	-16.81			
2/4-11/32	Timothy hay	87.90	36.12			Timothy hay.	87.90	36.12		
	Silage	53.80	47.70			Silage	53.80	47.70		
	Grain	49.06	152.06			Dried grass..	116.39	81.48		
	Total	190.76	235.88			Total	258.09	165.30		
	Milk	83.44	59.78			Milk	65.87	46.24		
Urine	13.44	0.67			Urine	0.14	0.61			
Feces	135.15	182.38			Feces	229.49	137.96			
Total	232.03	242.83			Total	295.50	184.81			
Balance	-41.27	-6.95			Balance	-37.41	-19.51			
2/11-18/32	Timothy hay	87.90	36.12			Timothy hay.	87.90	36.12		
	Silage	50.11	45.42			Silage	50.14	45.42		
	Grain	47.30	152.15			Dried grass..	122.55	85.84		
	Total	185.31	233.69			Total	260.59	167.38		
	Milk	78.38	59.85			Milk	68.33	47.83		
Urine	10.20	0.77			Urine	0.14	0.58			
Feces	124.15	184.77			Feces	209.80	132.30			
Total	212.73	245.39			Total	278.27	180.71			
Balance	-27.42	-11.70			Balance	-17.68	-13.33			

TABLE 19—SUMMARY SHOWING RELATIONSHIP OF MINERAL BALANCES TO MINERALS IN RATIONS AND MILK YIELDS BY WEEKLY PERIODS

Cow	Ration of hay, silage and dried grass					Ration of hay, silage and grain				
	Minerals in ration		Milk yield	Mineral balances		Minerals in ration		Milk yield	Mineral balances	
	Calcium	Phosphorus		Calcium	Phosphorus	Calcium	Phosphorus		Calcium	Phosphorus
	grams	grams	kilo-grams	grams	grams	grams	grams	kilo-grams	grams	grams
23	393	283	91.6	-15.4	- 0.6	240	389	116.4	-45.6	- 1.6
	386	269	91.9	-10.7	+ 2.6	245	398	104.1	-37.3	- 5.8
						250	353	85.8	-15.8	+ 3.
						232	359	83.7	-17.2	+10.7
50	327	219	60.6	-22.2	-21.3	192	258	48.2	-35.6	-20.3
	326	223	58.6	+25.6	+10.9	207	259	45.	-18.5	+ 3.6
	293	179	40.5	+20.1	+14.3					
	273	182	39.2	+12.1	- 1.3					
55	292	187	67.3	-22.	-16.7	194	300	83.1	-39.2	-21.7
	288	184	62.2	- 7.1	- 7.8	177	248	80.2	-63.9	-63.9
						177	228	71.9	-40.6	-34.1
						191	236	59.6	-41.3	- 7.
						185	234	59.4	-27.4	-11.7
56	297	191	60.8	-26.	-32.4	155	193	46.1	-70.4	-32.7
	277	179	59.1	-13.6	-14.1	156	194	45.3	-40.7	-16.8
	277	181	52.7	- 8.9	- 7.9					
	258	165	42.8	-37.4	-19.5					
	261	167	45.	-17.7	-13.3					
Average	304	201	59.4	- 9.5	- 8.2	200	281	71.4	-38.	-15.3
Ratio Calcium: Phosphorus	1.51: 1					0.71: 1				

calcium and phosphorus, averaging losses of 9.5 grams calcium and 8.2 grams phosphorus. On the grain ration all 13 of the calcium balances and 10 of the phosphorus balances were negative, three of the latter being positive. The average losses were 38 grams calcium and 15.3 grams phosphorus.

The greater losses in both minerals occurred when the grain ration was fed. However the milk yields averaged 12 kilograms higher on this ration than when its competitor was fed. This, when applying the average analyses of the minerals in the milk, would account for approximately 18 grams of calcium and 12 grams of phosphorus. Deducting these amounts from the balances obtained the losses would be reduced to 20 grams of calcium and 3.3 grams phosphorus. Furthermore the amount of minerals in the two rations varied, there being more calcium and less phosphorus in the dried grass ration and less calcium and more phosphorus in the grain ration. Taking these sundry factors into account it would seem fair to say that the availabilities of the calcium and phosphorus in the two rations were much the same.

SUMMARY

Digestion trials with dairy cows fed solely on artificially dried young grass and on fresh green young grass indicated that both are highly digestible and essentially equally digestible. On a basis of 90.17 percent dry matter the total digestible nutrient contents of the dried grass was 64.37 percent and of the green grass 63.36 percent.

In trials comparing a ration of timothy hay, corn silage and dried grass with a ration of timothy hay, corn silage and grain, some variation was observed in the digestibility of the various nutrients in the two rations. The dry matter, crude protein and nitrogen free extract contents of the two rations were not dissimilar but marked differences occurred with those of crude fiber and ether extract. The crude fiber of the grain ration was 16.7 percent less digestible than that of the dried grass ration, while on the other hand the ether extract in the dried grass ration was 30.1 percent less digestible than that in the grain ration.

Mineral balances of calcium and phosphorus obtained in the digestion trials show no indication of greater availability of these minerals in the dried and green grass rations than in the grain ration.

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