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J. W. HIBBS

H. R. CONRAD

R. W. VAN KEUREN

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER
U. S. 250 and OHIO 83 SOUTH
WOOSTER, OHIO

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J. W. HIBBS, H. R. CONRAD, and R. W. VAN KEUREN[1]

INTRODUCTION

Continued interest in the convenience and reduced labor in mechanized feeding has prompted a series of experiments to assess the relative merits of ensiling the concentrate with different forage crops to make a complete feed compared to ensiling the forage alone and adding the concentrate at feeding time. When corn silage is made, a significant share of the concentrate portion of the diet (kernels) is unavoidably ensiled with the forage.

Pardue *et al.* (4) found no difference in performance of cows fed a complete feed corn silage diet with the concentrate added at ensiling compared to grain added at feeding time using a 20.6% protein grain mixture as 40% of the total ration DM. Hooven *et al.* (2) compared a complete feed corn silage diet containing 40% grain concentrate (27.9% protein) with control cows fed corn silage free choice plus alfalfa hay at 0.5% body weight and the same concentrate mixture fed at the rate of 1 kg to 3 kg of milk produced. In early lactation (0-120 days), the control cows ate more DM and produced more milk than cows fed the complete feed silage. In late lactation (121-240 days), there was no difference in performance between the two diets.

In a previous OARDC study (1), complete corn silage diets in which the concentrate was added at time of ensiling were compared in three experiments with complete corn silage diets in which the concentrate was added at feeding time. In these three experiments with the cows fed complete silage, concentrate added at time of ensiling, average dry matter (DM) intake was 16.1 kg/d, 4% fat corrected milk (FCM) was 21.5 kg/d, and average rate of decline in 4% FCM was 0.07 kg/d. When the concentrate was added at time of ensiling, the cows in all three experiments consumed an average of 0.7 kg/d less DM, produced 0.5 kg/d more 4% FCM, and declined in milk production 0.017 kg/d slower than when the concentrate was added at feeding time.

Pratt and Conrad (5) had previously shown that DM intake and milk production were higher when ground ear corn was fed with high

[1]Professor and Associate Chairman, Dept. of Dairy Science, Professor of Dairy Science, and Professor of Agronomy, respectively, Ohio Agricultural Research and Development Center, Wooster, Ohio.

moisture (24-32% DM) grass-legume silage than when high moisture ear corn silage was used as the concentrate. The nitrogen (protein) from alfalfa hay also was utilized more completely than that from alfalfa silage. It was concluded that for highest DM intake and milk production, some unfermented concentrate or hay is needed to supplement high moisture grass legume silage.

In the experiment reported here, vernal alfalfa and several grasses were ensiled in layers separated by plastic sheets in two 10 x 40-foot concrete stave silos. The control (north) silo had no concentrate added at time of ensiling; rather, the concentrate was added as 50% of the DM twice a day at feeding time. In the experimental (south) silo, 50% of the DM was concentrate mixed with the forages in each layer at time of ensiling.

An opportunity was thus afforded to observe the effect of the various ensiled forage crops on voluntary intake and milk production and to further assess the effect of adding the concentrate at time of ensiling compared to mixing the concentrate with the silage at feeding time.

The complete silage concentrate mixtures were fed on a free choice basis so that voluntary intake could be expressed.

EXPERIMENTAL PROCEDURE

Between May 13 and May 21, 1969, six different grasses were harvested as near as possible in the same stage of maturity (boot-pre-emergence). Included were early (Potomac) orchardgrass harvested May 13, late (Pennlate) orchardgrass harvested May 13, reed canarygrass harvested May 15, early (common) timothy harvested May 16, smooth (Lincoln) bromegrass harvested May 21, and late (Essex) timothy harvested May 21. Vernal alfalfa harvested May 26 in the pre-bloom stage was included for comparison with the grasses.

After wilting, the forages were chopped and alternate loads were stored in two 10 x 40-foot silos in layers separated by plastic sheets in the order indicated above. In the experimental (south) silo, concentrate was mixed with the chopped forage at the rate of 50% concentrate to 50% forage dry matter at time of ensiling. No concentrate was added to the control (north) silo at time of ensiling. However, 50% concentrate was mixed with the control silage on the dry matter basis at feeding time during the subsequent feeding experiment, making the composition of the complete control diet similar to the complete experimental diet.

The composition of the concentrate used (D-189-69) was ground shelled corn, 97%; diammonium phosphate (Duofos), 2.0%; and iodized salt, 1.0% (11% total protein). When mixed with the grasses, 250 g of ground limestone per 100 lb was added to the concentrate to provide additional calcium. No limestone was added when the forage was alfalfa.

The number of days each layer of silage was fed varied from 7 to 18 days, averaging 12.3 days depending on the amount of silage in each layer. Changes from one layer to the next were made abruptly with no transition period.

Four Holstein cows were included in each group. The control group averaged 628 kg body wt at the beginning of the experiment. Average day of lactation at the beginning of the experiment on June 18 was 134 days for the control group and 128 for the experimental group.

RESULTS AND DISCUSSION

Table 1 shows the average percent dry matter and the average percent total protein in the silages sampled as fed during the feeding experiment extending from June 18, 1969, until Sept. 11, 1969. Table 2 shows the effect of the different ensiled forages and the two methods of feeding concentrates on dry matter intake and actual milk production.

As the silage layers were fed in complete diets beginning with alfalfa, there were marked differences in DM intake. Based on the least squares mean of both the control and experimental group, there was a significant reduction in DM intake from 18.3 kg/d to 14.8 kg/d when the silage was changed from alfalfa to late timothy. The next layer was smooth bromegrass with a DM intake of 16.4 kg/d, significantly less than alfalfa but not significantly more than late timothy. Dry matter

TABLE 1.—Average Dry Matter and Total Protein Content of the Silages Sampled as Fed.

Forage in Silage Layer (Top Down)	Dry Matter, Percent		Total Protein, Percent	
	North Silo Control*	South Silo Experimental†	North Silo Control*	South Silo Experimental†
Vernal Alfalfa	41.6	57.4	25.4	19.0
Essex Timothy	29.7	44.5	19.2	14.4
Lincoln Bromegrass	36.3	51.5	20.0	15.3
Early Timothy	31.0	49.0	18.4	15.7
Reed Canarygrass	36.1	51.3	19.9	15.5
Late Orchardgrass	43.8	61.8	21.5	17.0
Early Orchardgrass	35.8	51.1	18.1	15.7
Average	36.3	51.5	20.4	16.1

*50% concentrate dry matter mixed with 50% silage dry matter at feeding time, making the composition of both complete diets similar.

†50% concentrate dry matter mixed with 50% forage dry matter at time of ensiling to make a complete diet.

intake for early timothy and smooth bromegrass, reed canarygrass, late orchardgrass and early orchardgrass averaged 16.8 kg/d, 16.7 kg/d, and 15.6 kg/d, which were significantly higher than either of the timothy varieties and not significantly different from alfalfa or smooth bromegrass.

The combined average DM intake of all the silage layers for the experimental group (50% concentrate mixed with forage at time of ensiling) was 15.7 kg/d, significantly less than the 17.8 kg/d average DM intake for the control group. This result is in line with the previous experiment (1) where 0.7 kg less DM was consumed daily by lactating cows fed corn silage with 50% concentrate mixed with corn silage at time of ensiling compared to the control group where 50% concentrate was mixed with the corn silage at feeding time.

In Table 2, DM/body weight$_{kg}$ is also shown so that DM as percent BW_{kg} can be compared both for the different forages and the method of feeding concentrates.

Milk production dropped significantly when the cows were shifted from the preliminary pasture plus concentrate diet to the alfalfa silage diet. Based on the least squares mean of both control and experimental groups, there was a further significant drop in milk yield from 26.6 kg/d to 23.0 kg/d when the change was made from alfalfa silage to late timothy. Average production when fed the diet containing 50% reed canarygrass, 24.0 kg/d, was not significantly different from late timothy, 23.0 kg/d. Milk production when the cows were fed any of the other grasses was significantly less: smooth bromegrass, 22.0 kg/d; early timothy, 21.8 kg/d; late orchardgrass, 22.3 kg/d; and early orchardgrass, 22.0 kg/d. Average milk production was significantly higher in the control group than in the experimental group where the concentrate was mixed with the forage at time of ensiling, a reflection of the 2.1 kg/d higher DM intake in the control group. The control cows gained 0.33 kg BW per day while the experimental cows lost 0.23 kg daily. The difference in mean body weight change was not significant ($P = .05$).

The overall average milk production throughout the experimental feeding period was lower than the expected production compared to a normal decline from the initial level of 0.109 kg/d after the peak of production in herdmates fed a balanced 50% concentrate diet (1 part concentrate/1 part alfalfa hay/1 part corn silage—DM basis) (Table 2).

It is concluded that even when high quality grasses are fed as silage, DM intake will be less than when high quality alfalfa silage is fed, apparently due to slower rate of cellulose digestion of the grasses (3). The reduction in DM intake will be reflected in lowered milk production, further emphasizing the value of high quality alfalfa in maintaining

TABLE 2.—Effects of Different Ensiled Forages and Methods of Feeding Concentrates on Dry Matter Intake and Milk Production.

Forage in Silage Layer (Top Down)	Days Fed	Dry Matter Intake			Dry Matter Intake/BW_{kg}			Milk Production			Expected Milk Production Average** kg/d
		Control* kg/d	Experimental† kg/d	LSM‡ kg/d	Control* % BW_{kg}	Experimental† % BW_{kg}	LSM‡ % BW_{kg}	Control* kg/d	Experimental† kg/d	LSM‡ kg/d	
Preliminary -- Pasture	--	--	--	--	--	--	--	32.5	31.1	29.2[a††]	31.8
Vernal Alfalfa	13	19.8	17.8	18.3[a††]	3.03	2.83	2.85	29.5	27.9	26.6[b]	30.8
Essex Timothy	18	16.8	13.3	14.8[c]	2.57	2.12	2.30	24.8	23.3	23.0[cd]	29.0
Lincoln Bromegrass	9	18.0	15.0	16.4[bc]	2.75	2.39	2.56	24.7	19.9	22.0[d]	27.6
Common Timothy	16	15.3	14.9	15.2[c]	2.34	2.37	2.37	22.4	20.4	21.8[d]	26.2
Reed Canarygrass	13	18.5	16.8	18.1[ab]	2.83	2.68	2.82	24.0	21.9	24.0[c]	24.6
Late Orchardgrass	7	18.5	16.7	18.1[ab]	2.83	2.66	2.82	21.3	19.5	22.3[d]	23.5
Early Orchardgrass	10	17.8	15.6	17.3[ab]	2.72	2.48	2.70	19.3	20.0	22.0[d]	22.6
AVERAGE	12.3	17.8[e]	15.7[f]	16.9	2.72	2.50	2.63	24.8[g]	23.0[h]	23.9	27.0

*Concentrate mixed with forage at feeding time -- (50% of dry matter) -- complete diet fed free choice.

†Concentrate mixed with forage at time of ensiling -- (50% of dry matter) -- complete diet fed free choice.

‡Least squares means (milk production adjusted for day of lactation -- average 131 days at beginning of experiment).

**Based on 0.109 kg/d decline after the peak in herdmates fed a balanced 50% concentrate diet (1 part concentrate/1 part alfalfa hay/1 part corn silage -- dry matter basis).

††Superscripts which differ indicate a statistically significant difference ($P < .05$) -- least squares analysis of variance.

maximum DM intake in high producing cows without excessive grain feeding. When the concentrate is mixed with the forage at time of ensiling, dry matter will be lower compared to mixing the same amount of the same concentrate with silage made from the same forage at feeding time. The lowered dry matter intake can then be expected to be reflected in lowered milk yield.

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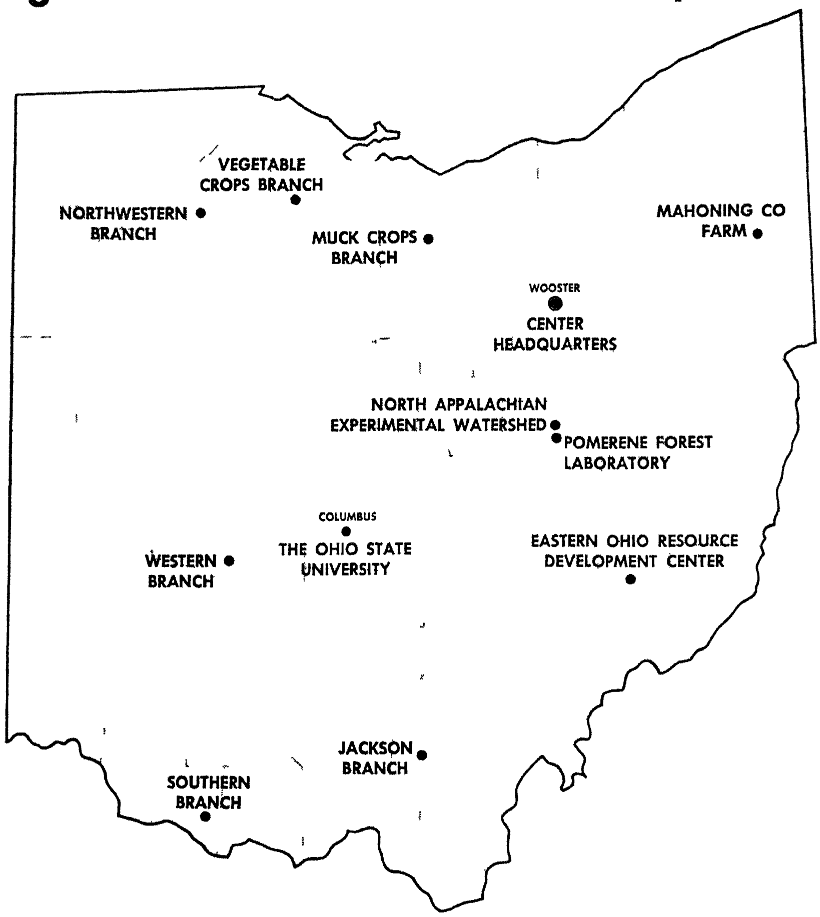

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