EFFECT OF TIMED INTERVAL FREQUENT FEEDING
OF PREDOMINANTLY CORN SILAGE RATIONS
TO BEEF STEERS

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CORN silage is being utilized in increased quantities in beef cattle growing and fattening rations. The research data of Hammes et al. (1964), with various ratios of corn to corn silage in fattening rations, have demonstrated that higher levels of corn silage can be justified because gains between high grain and high silage rations are similar, whereas, use of higher silage rations permits the harvest of a larger amount of total digestible nutrients per ha. of corn.

Undoubtedly, the introduction of mechanical devices for handling rations has increased the use of silage. The time clock unloading and feeding equipment which permits time-interval feeding of rations at predetermined intervals has been of special interest to cattle feeders. The objective of this research was to study the effect of timed-interval feeding of predominantly corn silage rations on the performance of beef cattle.

Experimental

Two feeding experiments and one metabolism experiment were conducted to determine the feeding value of predominantly corn silage rations fed six times per day, with the more conventional method of hand-feeding twice daily. In a reversal design metabolism experiment, four steer calves were utilized to determine the comparative digestion coefficients of the various ration nutrients for the two types of feeding.

Experiment 1. Forty steer calves averaging 300 kg. were randomly assigned, within weight strata, to two treatments of 20 animals each. One treatment group was hand-fed twice daily (8:00 a.m. and 5:00 p.m.) a ration of a full feed of corn silage plus 908 gm. Purdue Supplement A and 908 gm. cracked shelled corn per head, daily. The other treatment group received the same type ration, except the ration was fed in six equal portions at 4 hr. intervals (2, 6 and 10 o’clock) throughout the 24-hr. day. No attempt was made to keep the silage consumption of the two lots the same. The two groups were housed in different locations in the same barn to prevent the hand-fed group from becoming aroused and, possibly, stimulating eating due to the sound of the feeding mechanism or the sight of other cattle eating.

Feeding of the timed-interval-fed group was controlled through a central control panel activated by a time clock which started the silo unloader, conveyers, a meter for the supplement and grain mixture, the bunk feeder, and a warning bell and light as a safety indicator of the imminent starting of the entire unit. The various parts of the system started and stopped in sequence so that the entire system was cleaned out at the end of each operation, and the measuring of the grain and supplements coincided with the arrival of the silage at that point in the conveying system. The amount of silage removed from the silo per feeding was controlled by the length of time the machine ran and the rate of descent of the unloader. Silage unloading rates varied approximately 10% above or below the desired rate of 45 kg. per min. during the 2 min. operation of the unloader.

Weighed amounts of the supplement and grain mixture were placed in the bin supplying the feed meter. In the feeding tube, the mixture of corn silage, supplement and grain was augered to the end, at which time the tube rotated to dump along the entire length of the feeding trough. In each feeding operation, the tube dumped its contents four times. The automatic control system had fail-safe features to turn off the entire unit and light a signal lamp when a power failure occurred or when any motor in the system was overloaded. The
timing was by thermal time delay relays operated from a controlled voltage power supply, and time accuracy was within ±1% under the operating conditions. Only one component failure was noted in the experimental automatic control system during the period of operation, and the control system did not malfunction at any other time.

**Experiment II.** Forty steers averaging 209 kg. were allotted randomly within weight strata into two lots of 20 each. Experimental design, pen assignments and feeding regimes were essentially the same as for experiment I, except that two phases were utilized in experiment II. The first phase was known as the “growing” phase, and a program of a full feed of corn silage plus 908 gm. each of supplement A and cracked shelled corn per head daily was fed. The first phase was 112 days in length. The second or “finishing” phase was 56 days in length, and the level of cracked shelled corn was increased to a level of from 4.5 to 4.7 kg. per head daily, along with 908 gm. of supplement A and limited corn silage.

**Experiment III.** Four Holstein steer calves were used in a reversal design digestion trial to determine the digestibility of the ration constituents of a full feed of corn silage supplemented with 908 gm. Supplement A, when fed twice daily vs. timed interval fed six times daily at 4 hr. intervals. The simple reversal design was chosen because of its proposed effect on error by permitting each animal used to act as its own control. The four steers were paired according to weight, and one steer from each pair was either frequently-fed or conventionally fed. Feeding within pairs was conducted by the paired feeding method in which both animals were offered the same amount of feed at the level determined by the animal of the pair which consumed the least. Typical procedures of collection were followed, and analyses of feed and feces were conducted as outlined by A.O.A.C. (1960). Digestible energy determinations were made by use of a Parr Adiabatic Oxygen Bomb Calorimeter.

Rumen samples were taken 4 hr. after the final feeding of the first digestion trial. Rumen samples were taken by means of a suction pump and stomach tube inserted into the rumen. Fluid obtained was strained through four layers of cheesecloth, and 50 ml. of it was combined with 10 ml. of 25% metaphosphoric acid and, subsequently, centrifuged. The supernatant was then analyzed for acetic, propionic, butyric, isovaleric and valeric acids.

Statistical analysis was conducted on the feeding trials and metabolism study by applying procedures described by Steel and Torrie (1960). Average daily gains for both feeding trials were subjected to analysis of variance with equal replication to determine the significance of means between the two treatments. The metabolism study was analyzed as a $2 \times 2$ factorial, subjecting the digestion coefficients of dry matter, crude protein, crude fiber, nitrogen free extract, ether extract and energy to analysis of variance.

**Results and Discussion**

**Experiment I.** Calves on both treatments gained satisfactorily under both methods of feeding the predominantly corn silage ration. Average daily gains of 0.97 kg. and 0.93 kg., for calves fed two times and six times per day, respectively, were not significantly different (table 2). Silage consumption, although not

<table>
<thead>
<tr>
<th>Feed</th>
<th>Moisture</th>
<th>Crude protein</th>
<th>Crude fiber</th>
<th>Fat</th>
<th>NFE</th>
<th>Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn silage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shelled corn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplement A</td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

* Analyses are on a dry matter basis.

restricted, was similar between the two treatment groups (16.1 vs. 15.4 kg., respectively for 2X- and 6X-feeding). At the beginning of the experiment, approximately 1 wk. was required to accustom the 6X-fed steers to consuming the night feedings. Therefore, artificial lighting was used for 1 wk. to aid the cattle in becoming accustomed to the night feedings. Furthermore, since the 6X-fed cattle had fresh silage more often, they became more selective in their eating habits as indicated by refusal of the larger cob portions of the silage. As the ambient temperature fluctuated, the 6X-fed cattle were affected adversely more than the 2X-fed cattle based on consumption patterns.

**Experiment II.** Steers fed conventionally (twice daily) showed trends toward more rapid daily gain than 6X-fed steers (0.91 vs. 0.84 kg., respectively) during the growing phase. However, 2X-fed cattle consumed approximately 5% more total feed than the 6X-fed cattle so that calculated feed efficiency figures were similar between the 2 groups (table 2).

In the second or fattening phase of this experiment, the similarity of performance between the 2X- and 6X-fed steers continued
TABLE 2. COMPARATIVE EFFECT OF FEEDING TWICE DAILY AND SIX TIMES PER DAY ON GROWTH RATE, FEED CONSUMPTION AND EFFICIENCY OF FEED CONVERSION OF GROWING BEEF STEERS a

<table>
<thead>
<tr>
<th>Trial I</th>
<th>Trial II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Growing phase</td>
</tr>
<tr>
<td>No. times fed per day</td>
<td>2</td>
</tr>
<tr>
<td>Av. final wt., kg.</td>
<td>426</td>
</tr>
<tr>
<td>Av. daily gain, kg.</td>
<td>0.97</td>
</tr>
<tr>
<td>Daily feed consumption</td>
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</tr>
<tr>
<td>Corn silage, kg.</td>
<td>16.1</td>
</tr>
<tr>
<td>Cracked shelled corn, kg.</td>
<td>0.9</td>
</tr>
<tr>
<td>Supplement A, kg.</td>
<td>0.9</td>
</tr>
<tr>
<td>Feed per kg. gain a, b</td>
<td></td>
</tr>
<tr>
<td>Corn silage, kg.</td>
<td>6.3</td>
</tr>
<tr>
<td>Cracked shelled corn, kg.</td>
<td>0.9</td>
</tr>
<tr>
<td>Supplement A, kg.</td>
<td>0.9</td>
</tr>
</tbody>
</table>

**a** In trial I, 20 steers per treatment averaging 300 kg. initially; in trial II, 20 steers per treatment averaging 210 kg. initially. Trial I was 130 days; trial II, growing phase was 112 days, fattening phase was 56 days.

**b** In calculating feed required per kg. gain, corn silage was calculated on an air dry basis of 10% moisture.

(1.21 and 1.14 kg. gain per day, respectively). 

**Experiment III.** Four Holstein steers divided into two pairs had average pair weights of 160 and 127 kg. at the beginning of the two digestion trials, and gained weight during the trial. Digestion coefficients of the components analyzed (dry matter, crude protein, crude fiber, ether extract, NFE, energy and TDN) showed no significant differences between 2 X and 6 X feedings per day. When the treatments were reversed, using the same steers, once again no difference in digestibility of components was obtained (table 3). Similarly, the pattern of volatile fatty acid production was not affected significantly by 2 X vs. 6 X feedings per day (table 4).

For the most part, the growth studies reported here are not in complete agreement with other published data. Mochrie et al. (1956) reported improved daily gain in steer calves which were fed four times daily as compared to once daily. Rakes et al. (1957) observed a significant response in favor of frequent feeding when growing dairy animals were fed 10 X vs. 2 X daily. However, in subsequent research (Rakes et al., 1960), he suggested improved performance due to frequent feeding could be obtained with young growing animals, but not with the older more mature animal. Mohrman et al. (1959) reported increased gains with steer calves fed 6 X vs. 2 X feeding, and Putnam et al. (1961) also demonstrated that rate of gain was superior for 10 X vs. 2 X feeding.

The lack of difference in VFA production between 2 X and 6 X feeding is in agreement with Putnam et al. (1961) and Bath and Rook (1963) who found no significant difference in VFA production due to changing the time interval of feeding. On the other hand, Knox and Ward (1961) and Satter et al. (1962) in-
dicated that as the frequency of feeding increased, the even supply of feed materials gave rise to an even production of metabolites.

**Summary**

Eighty Hereford steer calves were used in two feeding trials (40 steers in each trial) and four steers in a reversal design metabolism trial to compare the effect of automatic frequent feeding (6 times per day) with hand feeding, twice daily, of predominantly corn silage diets to beef cattle. Although feeding trial I and the first phase of trial I were similar (growing ration), trial II also had a second phase in which calves received a finishing type ration.

In both feeding trials and on the two ratios of concentrate to roughage tested, no significant differences in the rate of gain were obtained between the two treatments. Although daily feed intake was not restricted, both treatments consumed practically the same amounts.

Results indicate no significant difference between the two treatments when comparing the digestibility of the various ration components.

**Literature Cited**


Bath, I. H. and J. A. Rook. 1963. The evaluation of cattle foods and diets in terms of the ruminal concentration of VFA; the effects of level of intake, frequency of feeding, the ratio of hay to concentrate in the diet, and of supplemented feeds. J. Agri. Sci. 61:341.


