Performance of Calves Fed Vitamin A
With Baled and Chopped Meadow Hay

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Considerable research has recently been devoted to vitamin A supple-
mentation for feedlot cattle on high concentrate diets. Based on these
investigations several workers have suggested recommendations for vitamin
A feeding which exceed previously established requirements. There has also
been a renewed interest in vitamin A research for cattle on high roughage
rations due to certain factors which are believed to interfere with vitamin
A utilization.

The processing of various kinds of hay into pellets and wafers for rumi-
nant feeding has been investigated by several workers. The advantages of
pelleted roughages have been clearly demonstrated, however, at present the
processing costs involved are sufficient to offset these advantages in most
cases. Information regarding comparisons of feeding the same hay in long and
chopped forms is more limited. Conceivably the chopping of coarse, stemmy
hay should reduce selection and waste and perhaps increase intake. Such
factors as selection and waste are usually of less concern when grass or fine
stemmed hay is fed.

The purpose of the work reported in this paper was to study the effect
of vitamin A supplementation in meadow hay wintering rations for calves
and to compare fine chopped, coarse chopped, and long hay in these rations.

EXPERIMENTAL PROCEDURE

Thirty-six Hereford steer calves averaging 400 lb. were stratified
by weight and randomly allotted to six lots of six animals each. Baled,
coarse chopped (4 - 6 in. lengths) and fine chopped (1 - 2 in. lengths)
meadow hay were fed to two lots each. One lot of calves fed each form of
hay received 20,000 I.U. of stabilized vitamin A per head daily while the
other lot received no vitamin A supplementation. In addition to hay all
lots were fed rolled barley and cottonseed meal at rates of 2 lb. and 1
lb., respectively, per head daily.

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The different forms of hay for each respective treatment were weighed into sheltered mangers daily and refusals were weighed weekly. Barley and cottonseed meal were fed daily in feed troughs and vitamin A was mixed with the cottonseed meal for lots receiving this treatment. Water, salt, and a mineral mix were available to the animals at all times. During the 120-day study each animal was weighed periodically following an overnight shrink. After final weights were taken, blood and liver biopsy samples were obtained from a random group of six animals from the control and six animals from the vitamin A supplemented treatments for carotene and vitamin A analyses.

The meadow hay fed in this trial came from the same meadow and was harvested at similar dates. Chemical composition of the three forms of hay fed is shown in table 1. Aliquot samples of refused portions of each form of hay were composited over the trial for chemical analyses.

Table 1. Chemical composition of different forms of hay 1/.

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Form of Hay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bale</td>
</tr>
<tr>
<td>Cellulose, %</td>
<td>31.2</td>
</tr>
<tr>
<td>Crude protein, %</td>
<td>8.9</td>
</tr>
<tr>
<td>Carotene, mg./lb.</td>
<td>21.3</td>
</tr>
</tbody>
</table>

1/ Dry matter basis.

RESULTS AND DISCUSSION

Vitamin A Feeding. Vitamin A supplementation had no significant effect on rate of gain, however, calves fed vitamin A had slightly more efficient gains (table 2). When all forms of hay were averaged there was no significant difference in hay consumption resulting from vitamin A supplementation.

Rations fed in this study furnished an average of over 200 mg. of carotene per steer daily which far exceed current recommended requirements of the National Research Council. Numerous workers (Ralston and Dyer, 1959; Wheeler et al., 1957; Church et al., 1956; and Weichenthal et al., 1963) have reported that beef cattle fed rations containing sufficient carotene have no difficulty in meeting their vitamin A requirements. On the other hand, Jordon et al. (1963) noted vitamin A deficiency symptoms in steers wintered on corn silage rations containing adequate carotene and Perry et al. (1962) reported improved performance resulting from vitamin A supplementation for steers fed a ration supplying adequate carotene.

Liver vitamin A stores were significantly increased (P < 0.01) and plasma vitamin A was slightly higher in steers supplemented with stabilized vitamin A (table 3). Non-supplemented animals, however, had higher levels.
of plasma carotene. Both Mitchell et al. (1960) and Perry et al. (1962) also
found that vitamin A supplementation tended to lower plasma carotene. The
data from this study along with the earlier work of Pope et al. (1961) and
Ralston and Dyer (1959) point out that plasma analyses of carotene or vita-
imin A are not reliable indicators of hepatic vitamin A stores.

Table 2. Performance of calves fed vitamin A with three forms of meadow hay.

<table>
<thead>
<tr>
<th>Form of Hay</th>
<th>Average Performance</th>
<th>Vitamin A Suppl.</th>
<th>Coarse Chopped</th>
<th>Fine Chopped</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Baled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily gain, lb.</td>
<td>None</td>
<td>1.35</td>
<td>1.31</td>
<td>1.32</td>
<td>1.33</td>
</tr>
<tr>
<td></td>
<td>20,000 I.U.</td>
<td>1.41</td>
<td>1.40</td>
<td>1.36</td>
<td>1.39</td>
</tr>
<tr>
<td>Da. hay cons., lb.</td>
<td>None</td>
<td>10.8</td>
<td>10.5</td>
<td>11.1</td>
<td>10.8</td>
</tr>
<tr>
<td>1/</td>
<td>20,000 I.U.</td>
<td>10.3</td>
<td>11.1</td>
<td>11.3</td>
<td>10.9</td>
</tr>
<tr>
<td>Feed per lb. gain,</td>
<td>None</td>
<td>10.2</td>
<td>10.3</td>
<td>10.7</td>
<td>10.4</td>
</tr>
<tr>
<td>lb. 2/</td>
<td>20,000 I.U.</td>
<td>9.4</td>
<td>10.1</td>
<td>10.5</td>
<td>10.0</td>
</tr>
</tbody>
</table>

1/ Consumption of fine chopped hay significantly greater (P < 0.01) than
baled or coarse chopped hay.

2/ Included hay plus 2 lb. barley and 1 lb. of cottonseed meal per head daily.

During the first month of the trial a number of calves developed pink-
eye. Vitamin A feeding was of no apparent benefit in correcting this
condition nor did it exert any other beneficial side effect during the
course of the study.

Table 3. Average final plasma and liver vitamin A and plasma carotene
values for calves fed meadow hay with and without vitamin A
supplementation 1/.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Daily vitamin A suppl.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None 20,000 I.U.</td>
</tr>
<tr>
<td>Liver vitamin A, I.U./g. liver</td>
<td>103 323 2/</td>
</tr>
<tr>
<td>Plasma vitamin A, I.U./ml. plasma</td>
<td>1.33 1.50</td>
</tr>
<tr>
<td>Plasma carotene, mcg./ml. plasma</td>
<td>1.99 1.50</td>
</tr>
</tbody>
</table>

1/ Averages based on a random group of six animals sampled from supplemented
and six from non-supplemented lots.

2/ Significantly greater (P < 0.01) than control animals.
Form of Hay. No differences in rate of gain were observed among animals fed the different forms of hay although calves fed fine chopped hay consumed more hay ($P < 0.01$) than those fed coarse chopped or baled hay (table 2). Feed conversion favored calves fed baled hay over those fed either form of chopped hay. Gains were also more efficient on coarse chopped hay than on fine chopped hay.

Results of the gain data from this study were similar to those reported by Weub and Cmarik (1956) with timothy-alfalfa mixed hay but differ from those found by Cullison (1961) with coastal bermuda-grass hay. When hay constituted the major portion of the ration, chopping or grinding increased voluntary consumption but simultaneously decreased digestibility (Johnson et al., 1964; and Klosterman et al., 1961). This relationship probably accounts for the reason calves fed chopped and long hay gained at comparable rates in this trial even though consumption was greater in chopped-fed lots.

Hay refusals were significantly greater ($P < 0.01$) for fine chopped hay than either coarse chopped or baled hay and were also greater ($P < 0.05$) for coarse chopped than for baled hay (table 4). The crude protein content of refused portions of both forms of chopped hay was higher than that of the hay initially fed while that of baled hay was the same. Cellulose content of the refused portion of each form of hay fed was lower than the original hay however, this difference was negligible in the case of fine chopped hay. A part of the higher quality forage constituents in meadow hay is apparently rendered into a fine, unpalatable state during the chopping procedure. In earlier work at this station (Wallace et al. 1961) crude protein content of refusals and amount of refusals were significantly lower for pelleted than for chopped meadow hay rations.

SUMMARY

Baled, coarse chopped, and fine chopped forms of native meadow hay were fed to duplicate lots of Hereford calves (6 animals per lot) for a 120-day wintering period. One lot of calves fed each form of hay received 20,000 I.U. stabilized vitamin A per head daily.

Vitamin A supplementation had no significant effect on rate of gain but slightly improved efficiency of gain. Calves receiving supplemental vitamin A had substantially higher liver vitamin A stores and slightly higher plasma vitamin A but lower plasma carotene than control animals at the end of the study. No beneficial side effects were apparent from vitamin A feeding.

Physical form of hay fed did not effect rate of gain although fine chopped hay was consumed at a higher level than either coarse chopped or baled hay. Refusals were greater on fine chopped hay rations than others and were greater on coarse chopped hay than on baled hay. The crude protein content of refused portions of both forms of chopped hay was higher than that of the hay initially fed while refusals of baled hay were of the same protein content as that of the hay fed.
Table 4. Amount and composition of hay refusals from different forms of meadow hay.

<table>
<thead>
<tr>
<th>Item</th>
<th>Form of Hay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baled</td>
</tr>
<tr>
<td>Avg. daily refusal, lb.</td>
<td>0.39</td>
</tr>
<tr>
<td>Cellulose content /%,</td>
<td>23.5</td>
</tr>
<tr>
<td>Crude protein /%,</td>
<td>8.9</td>
</tr>
</tbody>
</table>

1/ Dry matter basis.

LITERATURE CITED


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