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FORAGE QUALITY AND CATTLE PERFORMANCE ON AMMONIATED COASTAL BERMUDAGRASS HAY WITH AND WITHOUT SUPPLEMENTAL FEED

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Summary

Feeding studies, utilizing a total of 60 Brahman x Hereford (F1) heifers, were conducted to determine the effect of ammonia treatment of mature 'Coastal' bermudagrass (*Cynodon dactylon* (L.) Pers.) hay fed with and without grain/protein meal supplement (S) on the growth of replacement heifers. Supplement consisted of 59% whole corn (*Zea mays* L.) and 41% guar (*Cyamposis tetragonoloba* (L.) Taub.) meal. Two 72-day trials were conducted concurrently and a third 92-day trial was conducted the following year. The four feeding regimes were (1) untreated hay alone (HAY), (2) ammonia-treated hay alone (AHAY), (3) HAY plus supplement (HAY+S), and (4) AHAY plus supplement (AHAY+S). Heifers were group fed, five per pen, with hay self-fed. Supplement was fed once daily. Ammoniation (3%) increased ($P<0.01$) *in vitro* dry matter disappearance (IVDMD), *in vitro* neutral detergent fiber digestibility (IVNDFD) and crude protein (CP) from 48 to 60%, from 56 to 70%, and from 6.9 to 11%, respectively. Mean average daily gains (ADG) across trials were 0.71, 1.08, 1.45 and 1.52 lb for HAY, AHAY, HAY+S and AHAY+S, respectively. Average daily gains were increased by ammoniation without supplementation ($P<0.05$), but not with supplementation ($P>0.05$).

Introduction

Coastal bermudagrass is the predominant warm-season forage used for hay production in the southern U.S. This warm-season perennial grass can produce good quality forage if harvested at an immature growth stage. However, Coastal bermudagrass is often harvested at an advanced stage of maturity resulting in a low quality product. The resulting product may be of sufficient quality to supply the maintenance needs of a mature cow in good condition but is of marginal nutritional value for young growing cattle.

Limited research has been reported concerning the feeding value of ammoniated perennial warm-season grass hay. Brown (1987) reported that animal performance on ammoniated 12-week regrowth of 'Ona' stargrass (*Cynodon nlemfuensis* Vanderyst) hay was

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comparable to untreated 6-week regrowth hay. Ammoniation of bermudagrass increased intake of hay by heifers (Wyatt et al. 1989) and steers in addition to increased ADG (Ocumpaugh et al. 1984). Little is known about the value of supplementing ammoniated bermudagrass hay for growing heifers. The objective of this research was to determine the effect of ammonia treatment of mature Coastal bermudagrass hay fed with and without a grain/protein meal supplement on the growth of replacement heifers.

Procedure

Hay treatment and analysis. Coastal bermudagrass hay for the feeding studies was produced from the same field in each of two years (1984 and 1985) at the Texas Agricultural Research Station-Beeville. Soil series is a Clareville sandy clay loam with a pH of 7.8 (fine, montmorillonitic, hyperthermic Pachic Argiustolls). Soils are low in P and high in K, thus, N and P fertilizer was used annually. Each year mature bermudagrass was cut and baled in large round bales. Average bale weights were 1144 lb (oven-dried basis) in 1984 and 1285 lb in 1985. Each year bales were labeled, weighed, sampled, and arranged in single-row (end-to-end) stacks. Hay to be treated was covered with 6 mil thick black plastic (20 x 100 ft) and sealed at the base by applying fence posts and soil to the edges of the plastic. Metal drums (55 gal capacity) with the top removed were placed under the plastic at each end of the stack. Sufficient fertilizer grade anhydrous ammonia was dispensed into the drums to equal about 3% of hay dry weight. Hay was treated at least 5 week before the start of each feeding trial, and the plastic was removed about 1 week prior to feeding. Untreated hay was handled in a similar manner but was not covered. Bales were reweighed and sampled just prior to feeding.

Six core samples were collected from each bale, dried, and ground to pass a 1 mm screen. Samples from each bale were analyzed for *in vitro* dry matter disappearance (IVDMD), crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), and *in vitro* NDF digestibility.

Growth trials. Feeding studies in 1984-85 and 1985-86 were similar except that two groups of cattle were fed in 1984-85, one was used in 1985-86. The 1984-85 trials used 20 Brahman x Hereford (F1) heifers in each trial for 72 days and the 1985-86 study used 20 Brahman x Hereford (F1) heifers for 92 days. All other aspects of the 1984-85 and 1985-86 studies were similar except for average initial weights. Hay was self-fed in slant-bar round bale feeders. To limit hay wastage, a new bale was provided to individual pens when it was determined

that remaining hay within the feeder would not allow ad libitum consumption. Four feeding regimes were used both years as follows: (1) nontreated hay alone (HAY), (2) ammonia-treated hay alone (AHAY), (3) HAY plus 2.4 lb whole shell corn and 1.7 lb guar meal (HAY+S), and (4) AHAY plus whole shell corn/guar meal (AHAY+S). Guar is a drought resistant summer annual legume that produces a seed from which a gum is extracted. The by-product, guar meal, is a 35% protein meal which has been shown to have feeding value equal to cottonseed meal for ruminants (Conrad and Neal 1964). The supplement was mixed, bagged and then fed daily. Cattle were fed in groups of five per pen.

In 1984-85, heifers were grouped into light (433 lb) and heavy (495 lb) (shrunk weights) when the trials started on 7 Nov. 1984 (Trial 1 and 2, respectively). In 1985-86, heifers averaged 629 lb when the experiment started on 14 Nov. 1985 (Trial 3). In Trial 1 heifers were supplemented at a rate of 0.95% of body weight (BW). Heifers in Trial 2 were supplemented at a rate of 0.83 and 0.65% BW in Trial 3. These levels (4.10 lb supplement/heifer/day) were intended to allow for gains of about 1.6 lb/day when fed with HAY. A trace mineral mixture and water were available free-choice. In both years, body condition was scored by visual appraisal (scale of 1 to 9; 1 = emaciated; 9 = obese) before the experiment started. Heifers were stratified into groups by weight and body condition score. Groups were randomly assigned to treatments. Cattle were weighed full weekly for the first 4 or 5 weeks, then every 2 weeks until the end of the study. Condition scores were determined at the end of each trial.

Statistical analyses were conducted using PC-SAS (SAS, Inst. 1985). All forage data comparing AHAY and HAY were analyzed using the General Linear Models (GLM) procedure. Differences between treatment means were compared using the F test. Observed cattle weights were fitted using the least squares procedure within the Regression procedure. The fitted gain values in the growth trial were analyzed as a 2 x 2 factorial using the GLM procedure. Duncan's multiple range test was used to separate means for across trials ADG.

Results and Discussion

Hay treatment and analysis. Laboratory quality changes (Table 1) due to ammoniating mature Coastal bermudagrass hay were similar to responses observed for other forages (Gates et al. 1987; Ward and Ward 1987). Averaged across bales and years, ammoniation increased ($P<0.01$) hay CP concentration from 6.9 to 11.0% and IVDMD from 48.4 to 60.0%. Concentration of ADF was not influenced ($P>0.05$) by ammoniation. Previous

reports indicate little, if any affect of ammoniation on percent ADF. Consistent with the results of Grotheer et al. (1985) and Brown and Johnson (1991), percent NDF of untreated hay was greater ($P<0.01$) than that of ammoniated hay. *In vitro* NDF digestibility increased ($P<0.01$) from 55.9 to 69.6% as a result of ammoniation. Similar effects with Coastal bermudagrass and other warm-season grasses have been reported (Grotheer et al. 1985; Brown et al. 1987). *In vitro* NDF digestibility ranged from 8 to 10 units higher than IVDMD. Increased fiber digestion likely accounts for the increase in IVDMD of treated hay.

Average bale weights decreased from harvest until they were fed (data not shown). The average loss was 2.5% for AHAY and 7.5% for HAY; however, variation was large and differences were not significant ($P>0.10$).

Growth trials. Average hay offered for ad libitum consumption is shown in Table 2 and should not be confused with actual voluntary intake which was not determined. There were no significant differences due to feeding treatments, but there was a trend for more hay to be offered to heifers receiving AHAY than HAY. The amount of hay offered tended to be less when supplement was fed than when no supplement was fed. Condition scores for heifers fed AHAY, HAY+S, or AHAY+S were generally higher across trials than heifers fed HAY (Table 2). Reproductive performance of growing heifers is closely related to both body condition and body weight (Granger et al. 1990).

When feeding treatments were compared (Table 2 and 3), there was an increase ($P<0.05$) in ADG due to ammoniation. Heifers fed supplement performed better ($P<0.05$) than did those fed no supplement. At the level of supplement fed in this study, there was no response ($P>0.05$) to ammoniation when HAY+S is compared with AHAY+S (Table 2).

It appears that the level of supplement in this study was sufficient to promote gains at a level high enough for HAY+S such that additional improvement in performance due to ammoniation was insignificant. The mixed supplement used in the current study was formulated to give gains of about 1.6 lb/day for the size animals used when fed with HAY. Gains for the three trials averaged 1.45 lb/day for HAY+S with a range of 1.39 to 1.56 lb/day. Heifers on AHAY+S were offered and assumed to have consumed about 17% more forage than heifers on HAY+S.

The results suggest that if a supplement is fed at a level sufficient to promote gains of greater than approximately 1 lb/day in young heifers, ammoniation of hay may not

improve gains significantly. Level of supplement fed and quality of hay utilized were apparently high enough that rate of passage was increased to a greater extent by ammoniation than was apparent digestibility, such that performance was only slightly improved by ammoniation when supplement was fed. Further research is needed to verify this conclusion but it appears to be a likely explanation for the lack of animal response to ammoniation when the supplement was fed.

Summary and Conclusions

Rate of growth of heifers is important to becoming reproductively capable. Heifer performance (ADG) was improved when ammoniated hay was fed compared to untreated hay (1.08 vs 0.74 lb/day). Heifers fed supplement grew faster than those not receiving supplement. Performance (ADG) of heifers failed to respond to ammoniation of hay when supplement was fed but ADG tended to be higher when ammoniated hay was consumed (1.45 vs 1.52 lb/day). The level of supplement fed in this study promoted a higher rate of gain (averaging 1.45 lb/day) when fed with untreated hay than in previous trials with steers where supplementation and ammoniation were compared. The quantity of supplement fed likely accounts for the lack of response to ammoniation when supplement was fed in these trials. At lower levels of supplemental feeding and expected daily gains, ammoniation would be expected to promote improved animal performance more economically than feeding additional supplement.

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Table 1. Laboratory analysis of untreated and ammoniated Coastal bermudagrass hays (DM basis), mean of all trials.

Lab Analysis	Untreated	Ammoniated	
	----------%----------		P > F
Crude protein	6.9	11.0	**†
Acid detergent fiber	37.3	38.5	NS
Neutral detergent fiber	77.6	72.9	**
In vitro dry matter disappearance	48.4	60.0	**
In vitro neutral detergent fiber digestibility	55.9	69.6	**

† NS, ** Nonsignificant (P > 0.05) and significant at the 0.01 level, respectively.

Table 2. Mean hay dry matter provided daily, average daily gain and ending body condition scores of heifers fed untreated (HAY) and ammoniated hays (AHAY), with and without a supplement (S).

Feeding Treatment	Hay offered daily †	Average daily gain Trial				Body condition scores ‡ Trial		
	mean	1	2	3	mean ± SD	1	2	3
		lb						
HAY	13.9	0.73	0.53	0.86	0.71[c§] ± 0.18	4.1	4.1	4.8
AHAY	14.7	1.08	1.13	1.04	1.08[b] ± 0.22	4.5	4.3	5.3
HAY+S	11.7	1.56	1.39	1.40	1.45[a] ± 0.29	4.6	4.4	5.1
AHAY+S	13.6	1.69	1.26	1.60	1.52[a] ± 0.31	4.5	4.5	5.0

† Calculated by dividing total hay offered by the number of animal days to when last bale was completely consumed. Hay wasted was not measured, but more HAY appeared to be wasted than AHAY.
‡ Scale of 1 to 9; 1 = emaciated; 9 = obese.
SD Standard Deviation.
§ Means in a column not followed by a common letter are significantly different at $P<0.05$.

Table 3. Mean average daily gain (ADG) by treatment main effects and trial of heifers fed ammonia treated and untreated Coastal bermudagrass hay with or without a corn/guar meal supplement.

Main effects	Trial		
	1	2	3
Hay treated with ammonia	day		
No	1.15	1.04	1.13
Yes	1.39	1.20	1.32
P > F	*†	NS	*
Fed supplement			
No	0.91	0.77	0.95
Yes	1.63	1.33	1.50
P > F	**	**	**

† NS, *, ** nonsignificant (P > 0.05) and significant at the 0.05 and 0.01 levels, respectively.