Protein Adjustments in Heat Stressed Finishing Cattle

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Summary

A summer feedlot trial indicates that protein can be removed from finishing rations in proportion to magnitude of heat stress without causing a decline in average daily gain. Cattle consumed .13 kg/hd/day (.30 lb) less supplemental protein (soybean oil meal) during the 82-day period with no decline in average daily gain when compared to controls.

Introduction

Exposure of feedlot cattle to effective temperatures above the thermal neutral zone (TNZ) increases the need for net energy for maintenance (NEm). Consequently, less net energy for production (NEg) is available and average daily gain (ADG) decreases. Since energy is limiting gain, protein is used for energy and not for the nitrogen needs of new tissue. This causes a decrease in protein efficiency (g protein/g gain). Logically, protein efficiency could be improved by matching protein intake with gain during heat stress. Previous work shows that mean daily temperature (MDT) can be used to predict ADG and that protein efficiency is improved when protein level is adjusted to expected performance level during cold (Cattlemen's Day, 1976).

Procedure

We used 216 head (117 steers, 99 heifers) of mixed breed finishing cattle for 82 days beginning June 3, 1976. Cattle were fed in eight outside lots. Going on test cattle averaged 354 kg (779 lbs). Cattle were fed ad libitum a high concentrate ration (Table 27.1) with protein varied for 110 head and a constant 12.1% crude protein for 106 control cattle. The supplemental protein (soybean oil meal) was handled as a single ingredient so amounts could be varied easily be replacing SBM with milo.

Protein adjustments were based on lowered ADG expected during hot weather. The formula, $ADG = 1.424 + .116\ C - .003\ C^2$ where gain is kilograms and C is temperature in degrees centigrade was used to predict gain during heat.

The equation was derived from data involving approximately 40,00 steers fed outdoors in Kansas. Protein for growth (Protein above maintenance where maintenance protein = $2.79\ W_{kg}^{.75}$) was adjusted according to expected effect of temperature on gain. All adjustements were made so that the rations would contain the same caloric value (see sample calculation). No attempt was made to lower protein more than removing all supplement. Daily temperature was recorded by a thermograph at the feedlot. Temperature at feeding time was used to determine protein fed each day.

Results and Discussion

ADG did not significantly ($P<.05$) differ between cattle consuming a constant percentage of protein (control) and those whose protein was adjusted for expected lower ADG during heat (Table 27.2). Steers adjusted on protein consumed .13 kg/hd/day (.30 lb) less than control steers. Theoretically, more protein could have been withdrawn but we removed only the amount included in the supplemental soybean oil meal.

Temperatures ranged from 52 F to 105 F during the test period; mean daily temperature was 78.5 F. Temperatures recorded at feeding time averaged 71.3 F for mornings and 89.0 F for afternoons.

The idea of changing rations to match environment is relatively new, although it has been long known that adverse weather decreases performance. To use energy and protein efficiently it is important to maintain constant protein:calorie ratio of protein and energy above amounts required for maintenance. This must be done with concurrent increases in net energy for maintenance and decreased voluntary intake during hot weather.

To refine the procedure more work is needed to establish accurate equations relating performance and environment. Because protein requirements are higher for growing cattle than for finishing cattle, changing protein in proportion to heat stress may work better with growing cattle than with finishing cattle. Higher protein requirements also would allow more protein to be replaced with grain during heat stress.

Table 27.1 . Basic ration fed cattle in heat stress tests.

	Dry Matter Composition %	Crude Protein %	Digestible Protein %
Milo	82.4	11.3	6.5
Sorghum silage	10.0	7.1	1.9
SBM	3.6	49.4	42.0
Trace mineral supplement (milo carrier)	4.0	8.4	4.8
Ration		12.1	7.3

[1]Calculated using NRC digestion coefficients.

Table 27.2. Effect of adjusting protein for expected ADG by finising cattle.

Treatment	CP %	ADG kg	ADG lb	SBM removed kg/hd/day kg	SBM removed kg/hd/day lb
Control	12.1	1.11	2.44	0	0
Adjusted	varied	1.14	2.50	.13	.30

Example of Calulating Protein Adjustment

Assumptions

Critical temperature = 60 F (15.6 C)
Mean daily temperature = 85 F (29.4 C)
Digestible protein intake = 800 g (Ration DP x DM Intake)
Weight = 800 lbs (363.6 kg; $83.25W_{kg}^{.75}$)
SBM digestible protein = 40 %
Milo digestible protein = 7.1 %

Step I: Decline in Gain

$$\text{Maximum gain} = 1.424 + .116\ (15.6) - .003\ (15.6)^2 = 2.503$$

$$\text{Predicted gain} = 1.424 + .166\ (29.4) - .003\ (29.4)^2 = 2.239$$

$$\text{Decline in gain} = 1 - \frac{2.239}{2.503} = .105 \text{ or } 10.5\%$$

Step II: Digestible Protein for Growth

DP Intake = 800 g

$$DP_m = 2.79W_{kg}^{.75} = 2.79 \times 83.25 = 232 \text{ g}$$

$$DP_g = \text{DP Intake} - DP_m = 800 - 232 = 568 \text{ g}$$

Step III: Replacement Factor

$$\text{R.F.} = 1 - \frac{\text{DP milo}}{\text{DP SBM}} = 1 - \frac{.071}{.40} = .83$$

Step IV: Substitute

$$\text{SBM replaced} = \frac{(DP_p)\ (\text{Decline in gain})}{(\text{R.F.})\ (\text{SBM DP})} = \frac{(568)(.105)}{(.83)(.40)} = 180 \text{ g}$$