Protein Adjustments During Temperature Stress

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Summary

Adjusting feedlot rations to match the thermal environment can reduce costs of gains. Adjusting protein content of rations does not change average daily gain but it improves protein efficiency.

Introduction

Rations for feedlot cattle are intended to provide a balance that results in the most efficient use of each nutrient. Energy and protein are balanced so about 12 Kcal energy for each gm protein remain after maintenance requirements are met. The most efficient use of both energy and protein result when calorie to protein ratio is appropriate for tissue synthesis. However, when energy required for maintenance increases, (as during thermal stress), energy available to synthesize tissue is reduced and the calorie-to-protein ratio above maintenance levels for both energy and protein is lowered. This results in reduced protein efficiency ratio (lb gain/lb dietary protein) and increased cost of gain during both heat and cold stress.

Dietary protein could be more efficiently used if it were fed in proportion to animal needs; enough for maintenance plus enough for the anticipated rate of growth. During thermal stress (either heat or cold) cattle gain less, so less protein is required. We applied that logic to feedlot situations expecting to improve protein efficiency without reducing average daily gain.

Methods

We conducted two preliminary trials with lambs and then four trials with cattle to evaluate the idea of matching protein to expected gain during thermal stress. In each trial, gain during stress was predicted with equations developed from recent feedlot and research data. Protein for growth (that in excess of maintenance) was adjusted to expected reduced gains. If gain was expected to be 15% lower, we lowered growth protein 15% but not protein for maintenance. A chart indicating the adjustments for a 900-lb steer follows.

Sample Ration Adjusted for Temperature

	Deviation (^{o}F) from critical temperatures	Decline in ADG,%	Protein for maintenance,g	Protein for growth,g	Protein needed in ration,g	Crude protein in ration,%
	45	52.3	251.8	269.7	521.5	7.66
	40	39.1	251.8	344.3	596.1	8.75
	35	27.7	251.8	408.8	660.6	9.70
	30	18.2	251.8	462.5	714.3	10.49
Hot	25	10.5	251.8	506.0	757.8	11.13
	20	4.8	251.8	530.3	790.1	11.60
	15	.7	251.8	561.4	813.2	11.94
	10	----	251.8	565.4	817.2	12.0
	5	----	251.8	565.4	817.2	12.0
Critical	0	----	251.8	565.4	817.2	12.0
temperature	5	2.3	251.8	552.4	804.2	11.81
	10	4.5	251.8	540.0	791.8	11.63
	15	6.8	251.8	527.0	778.8	11.44
	20	9.0	251.8	514.5	766.3	11.26
Cold	25	11.3	251.8	501.5	753.3	11.06
	30	13.5	251.8	489.1	740.9	10.88
	35	15.8	251.8	476.1	727.9	10.69
	40	18.0	251.8	463.6	715.4	10.51
	45	20.3	251.8	450.6	702.4	10.31

One must know the temperatures that required adjustments, i.e., the critical temperature. Estimates of critical temperature for feedlot cattle are given below.

Coat description	Critical temperature
Summer coat or wet	15 C (59 F)
Fall coat	7 C (45 F)
Winter coat	0 C (32 F)
Heavy winter coat	-7 C (18 F)

Results and Discussion

A total of 575 animals were used to evaluate protein adjustments during thermal stress, with the results shown in Table 15.1.

Table 15.1. Summary of six trials with ration protein adjusted to existing thermal environment.

Trial	Species	Mean temp.(°F)	ADG(lb.)[1] Control	Adjusted	PER[2] Control	Adjusted	Protein removed (lb/hd/da)
1	cattle	34	2.0	2.0	.97	1.10	.24
2	cattle	36	2.3	2.4	1.19	1.43	.33
3	cattle	79	2.4	2.5	.79	.91	.29
4	cattle	79	2.8	2.5	1.11	1.16	.35
5	sheep	23	.31	.33	.63	.93	.11
6	sheep	86	.55	.42	1.71	1.96	.09
			Average		1.07	1.25	

[1]No significant difference in mean ADG between control and adjusted groups.

[2]Highly significant (P=.006) difference in mean PER between control and adjusted groups.

Comparing average daily gains between controls on present NRC protein level and animals on adjusted protein levels, shows no difference, as expected. However, when gains are depressed during thermal stress (because energy for growth is reduced), protein efficiency ratio for adjusted rations is superior to the ratio for control rations. Thus, removing protein during thermal stress improved protein efficiency with no penalty in performance.

Adjusting protein reduces cost of gain because protein is more expensive than energy. For example, if the spread between soybean meal and corn is 5¢/lb., removing 1/3 lb. of soybean meal during thermal stress gives a 1.5¢-per-head daily saving. Price difference between protein supplement and energy feeds may increase or decrease such savings.

It is rather easy to use protein adjustments during thermal stress with most feeding systems. If feed is mixed daily, adjustments can be made using the chart given on the previous page. Smaller feeders who use mix batches, could save by developing rations based on monthly temperature records.