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Managing Feedlot Cattle to Reduce Nutrient Waste

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Management opportunities can reduce feed costs and the cost of excess nutrient waste outputs. The key to controlling excess nutrient output is controlling nutrient intakes. The question becomes whether nutrient excretion can be reduced without negatively impacting animal performance?

Balanced Rations

Nitrogen and phosphorus are the primary nutrients considered in nutrient waste management systems. Excess nutrient excretion can be controlled by properly balancing diets according to nutrient requirements for production.

The maintenance recommendations for phosphorus (NRC 1996) have been reduced by approximately 43% from 1984 NRC recommendations. The new recommendation is 0.22% P to meet nutrient needs for maintenance and gain of an 800 lb steer on a finishing diet. Erickson et al. (1998) conducted an experiment to evaluate animal performance across various levels (0.14 -0.34%) of P intake. Steer performance was measured as average daily gain (ADG), dry matter intake (DMI), and feed efficiency. These variables were not affected by P level in the diet. This suggests that when steer diets are balanced, producers can lower the P levels in the diet to the 1996 NRC recommendations without negatively affecting performance.

Most corn-based diets average 0.28 - 0.32 % P, exceeding the requirement for an 800 lb steer. The challenge then becomes lowering the phosphorus concentration of a corn-based diet.

Typically feedstuffs other than corn are needed to lower the phosphorus concentration of the diet. Comparing phosphorous book values of whole grains (barley, oats, sorghum, and wheat), corn has the lowest phosphorus level. Therefore, the best possible management alternative is to minimize additional supplementation of phosphorus.

Forages are typically lower in phosphorus than concentrates. However, lowering the ration P concentration by increasing levels of forage has the disadvantage of decreasing gains.

Protein (nitrogen) requirements can be divided into two segments, protein needed by the microbial population in the rumen and protein needed by the animal. Degradable intake protein (DIP) is the protein used to meet the microbial requirement and the animal requirement can be met by microbial protein leaving the rumen and by undegradable intake protein (UIP). Excess DIP is converted to ammonia and excreted in the urine.

Protein requirements change as the animal grows. There is an opportunity to reduce crude protein level of the diet. When a ration is balanced using DIP and UIP, usually the crude protein of the ration is lower than when balanced with crude protein levels.

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Feedstuffs vary in the amount of protein degraded in the rumen (DIP) versus small intestine (UIP). For example, dry-rolled corn is 40% DIP and high-moisture corn is 60% DIP with the same amount of crude protein (8-10%).

Protein sources also vary in DIP percentages, such as soybean meal 65%, cottonseed meal 57%, feathermeal 30% and fishmeal 40%. By using a variety of feedstuffs, UIP, and DIP requirements can be met at lower crude protein levels in the diet, thus reducing nitrogen excretion.

Phase Feeding

Phase feeding is a systematic method for adjusting the animal's diet during the feeding period to meet its nutrient requirements. Since nutrient requirements change as cattle grow, protein and phosphorus requirements can be reduced as an animal matures. This suggests the opportunity to reduce nitrogen and phosphorus intakes and excretion.

An experiment was conducted by the University of Nebraska to evaluate phase feeding with yearlings and calves. The concentrate portion of the diets was comprised of dry rolled corn, high moisture corn, or corn bran. Control (CON) steers consumed a diet of 13.6% CP, 4.48% UIP, and .34% P compared to a balanced (BAL) yearling diet that was systematically reduced during the feeding period from 11.9 -11.2 % CP, 3.67% UIP, and .24-.22 % P. Yearlings fed the balanced diet consumed less dry matter than the control steers (Table 1). However, no differences in ADG, feed efficiency, or carcass characteristics (data not shown) were found.

The second experiment involved calves. The control diet was 13.4% CP, 5.16% UIP, .35% P compared to the balanced diet (12.7-10.8% CP, 5.51-3.02% UIP, and .26-.20% P), which was phase-fed in 8 finishing diets. Calves fed the balanced diet had similar DMI, ADG, and feed efficiency as control calves (Table 1).

Table 1. Feedlot performance for yearlings and calves fed control or balanced rations.

	YEARLING		CALVES	
ITEM	**CON**	**BAL**	**CON**	**BAL**
Initial Wt., lb	652	660	539	542
Final Wt., lb	1249	1249	1245	1247
DMI, lb	26.2	25.0*	20.6	20.5
ADG, lb	4.06	4.01	3.66	3.65
F/G	6.45	6.21	5.72	5.64

Erickson et al., 1998
* P < .05

Phase feeding yearling steers reduced N and P excretion by 16 and 44% respectively (Table 2). This indicates improved nutrient output (i.e. lower N and P excretion) can be achieved without compromising animal performance.

Table 2. Nitrogen and Phosphorus Balance for yearlings.

	NITROGEN		PHOSPHORUS	
	CON	BAL	CON	BAL
	Lbs/hd/d		Lbs/hd	
Intake	.56	.47*	12.52	7.90*
Retention	.06	.06	2.05	2.03
Excreted	.50	42*	10.47	5.87*

Erickson et al., 1998
* P < .01

Phase feeding allows nutritionists to more effectively optimize performance without overfeeding. This improvement was demonstrated by reducing intake thus reducing potential feed costs. Additional cost savings could be realized by reducing the amount of nutrients excreted in animal waste.

A practical disadvantage of phase feeding is constantly changing diets. Phase feeding increases management requirements to ensure proper delivery of the correct diet. The risk of metabolic disorders that could occur with improper diet changes is increased in these systems.

Implants

Anabolic growth-promoting agents, commonly referred to as implants, are approved for use in steers and heifers targeted for harvesting. Characteristics of implanted cattle are enhanced growth rate, feed efficiency, and lean tissue accretion. Implanting steers on finishing diets has improved gains by 8-20% and feed efficiency by 5-15%. With implanted heifers, gains were increased 10-20% and feed conversion improved by 7-12%.

The increased tissue accretion suggests the possibility of reduced nutrient excretions. An example from Johnson et al. (1996) showed that the animals implanted with trenbolone acetate (TBA) + estradiol (E2) increased ADG by 18% (Table 3) during the 40 day period, suggesting that nitrogen and phosphorus retention would be higher in the implanted animals. Table 4 shows that the amount of nitrogen retained in the carcass was increased by 82% during the first 40 days for implanted animals. Similar intakes were observed in this study; therefore, the amount of nitrogen excreted would be less from implanted animals compared to control animals. Table 5 illustrates calculated estimates for reducing phosphorus excretion by implanting during the first 40 days. Phosphorus is needed for both maintenance

(Pm) and gain (Pg). Since the maintenance requirement is calculated from body weight, implanted animals have a slightly higher requirement. Phosphorus for gain is calculated as 3.9 g of P per 100 g of protein gain or 5.54 g P/d and 10.10 g P/d for control and implanted animals, respectively.

Since true absorption of phosphorus is 68%, 18.3 g P/d and 25.1 g P/d were needed by the control and implanted steers to meet their phosphorus requirements for maintenance and gain. The phosphorus balance calculations indicate potential for reduced phosphorus excretion.

Table 3. Feedlot Performance for initial 40 days of finishing period

ITEM	CONTROL	IMPLANTED
Initial Wt., lb	869	869
Days 0-40		
ADG, lb	3.89	4.58*
F/G	5.47	4.83*
DMI, lb	21.3	22.2
P Intake, g/d	26.14	27.19

Johnson et al., 1996
* P < .05

Table 4. Effect of TBA + E2 on Carcass Nitrogen

ITEM	CTL	IMP	CTL	IMP	%Response
	N Intake, g/d		Carcass N gain, g/d		
Days 0-40	186	193	18.2	33.1	82**
Days 0-115			18.9	25.3	34*
Days 0-143			18.2	22.7	25*
Days 41-115	192	210	19.5	20.3	4
Days 116-143	179	201	11.5	18.2	58

Johnson et al., 1996
** P < .01
* P < .10

Table 5. Phosphorus Balance for first 40 days

ITEM	CONTROL	IMPLANTED
P Intake, g/d	26.14	27.19
Pm, g/d	6.89	6.99
Whole Body Protein Gain, g/d	142	259
Pg, g/d	5.54	10.10
P Excreted, g/d	20.6	17.09
Estimated requirement, g/d	18.3	25.1
P Excess, g/d	7.8	2.09

Calculated from Johnson et al. 1996 data.

Summary

Ration balancing allows producers to manage the nutrient intake for optimum performance and minimizing nutrient output. Adjusting rations throughout the feeding period reduces potential of overfeeding of nutrient such as nitrogen and phosphorus. Use of implant and other growth enhancers permits for improvements nutrient retention, thus reducing nutrient output.

Reference

Erickson, G., M. Klemesrud, T. Milton, and T. Klopfenstein. 1998. Phosphorus Requirement of Finishing Yearlings. Nebraska Beef Report: 78-80.

Erickson, G., T. Milton, and T. Klopfenstein. 1998. Evaluation of 1996 NRC for Protein and Phosphorus Requirements of Finishing Cattle. Nebraska Beef Report: 84-85.

Johnson, B.J., P.T. Anderson, J.C. Meiske, and W.R. Dayton. 1996. Effect of a Combined Trenbolone Acetate and Estradiol Implant on Feedlot Performance, Carcass Characteristics, and Carcass Composition of Feedlot Steers. J. Anim. Sci. 74:363-371.

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