Bull Management for Commercial Producers: Nutrition

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Introduction

Breeding bulls, purchased or home-raised, are a large capital investment that needs to guarantee a return on the investment. However, the bull is often the nutritionally forgotten or most marginalized component of the beef cattle enterprise. This is unfortunate because proper bull management, particularly nutrition, is vital to ensure the long-term viability of the beef cattle enterprise. The bull contributes one-half of the genetics to each calf crop, without a functional bull, that contribution and an adequate calf crop is not realized. Therefore, proper and adequate nutritional management of the herd bulls is paramount to the breeding season success and economic viability of the beef enterprise.

Nutritional Management of Beef Bulls

There are a number of well defined nutritional periods during a bull's life.

1. Pre-puberal – pre-weaning.
2. Pre-puberal – post-weaning to 30-60 days pre-breeding.
3. Conditioning prior to the breeding season.
4. Management during the breeding season.
5. Management after the breeding season.

Pre-weaning

During this period the bull is at the dam's side and nutrition during this period is likely adequate to ensure normal growth and development. Exceptions would be indicated when the dam's nutritional environment limits milk production. Creep feeding of potential herd sire bulls is utilized in some instances. Currently, there is little or no data that have evaluated the long-term effects of creep feeding on bull performance.

Post-weaning

This period of nutritional development should allow the bull to grow at nearly the bull's genetic potential. The nutritional design of many growing programs or bull test station diets is a concentrate-based, low-roughage, high-energy diet. The goal of this period is to grow the bulls rapidly, but avoid excessive fat development. The nutritional program should also be designed to avoid digestive upsets or affect soundness. The high-energy, high-plane of nutrition also stimulates the onset of puberty particularly in later maturing breeds. Adequate research indicates that either under- or over-nutrition during this period can have detrimental effects on bull development, attainment of puberty, and semen quality. Well-designed bull test diets or purebred bull breeders with sound development programs should allow bulls to express their growth potential without any deleterious effects on future performance. The basic nutrient requirements of growing bulls are listed in Table 1.

Conditioning prior to the breeding season

This period is the most important next to the development phase, but that could be debated. Not only do growing bulls need this conditioning period, but mature bulls need to be conditioned before entering service during the breeding season. Growing bulls generally have just gone through the development phase which consisted of high-energy concentrate based diet. As such these bulls need to be cycled down from that high plane of nutrition. That means there needs to be a transition from the test diet or development diet to a conditioning or maintenance diet that is often forage-based. The transition to a forage-based diet often occurs when the bulls are losing their teeth, compounding the stress of the diet transition. The conditioning period should be around 60 days. This time frame should allow adequate time for the bulls to adjust to a new diet. For well conditioned bulls this

Table 1. Nutrient requirements of growing bulls and maintenance of mature bulls.[1,2]

			Diet nutrient density						Daily nutrient requirements				
BW, lb	ADG, lb/d	DMI, lb	TDN, % DM	NE_M (Mcal/lb)	NE_G (Mcal/lb)	CP, % DM	Ca, %	P, %	TDN (lb)	NE_M (Mcal)	NE_G (Mcal)	CP, lb	Vit. A 1,000 IU
1,000	1.0	20.7	56.0	0.54	0.28	8.1	0.25	0.19	11.6	11.20	5.80	1.66	36
1,000	2.0	22.3	63.0	0.63	0.37	8.9	0.30	0.20	14.0	14.00	8.25	1.99	39
1,000	3.0	22.8	70.5	0.75	0.47	9.7	0.36	0.21	16.1	17.10	10.70	2.23	39
1,100	1.0	22.3	56.0	0.54	0.28	7.9	0.23	0.19	12.5	12.00	6.24	1.75	39
1,100	2.0	23.9	62.5	0.63	0.37	8.6	0.28	0.19	14.9	15.06	8.84	2.07	42
1,100	3.0	24.5	70.5	0.75	0.47	9.3	0.32	0.21	17.3	18.38	11.52	2.29	43
1,200	1.0	24.8	56.0	0.54	0.28	7.8	0.23	0.19	13.9	13.39	6.94	1.93	40
1,200	2.0	26.1	63.0	0.64	0.38	8.4	0.28	0.19	16.4	16.70	9.92	2.19	43
1,200	3.0	26.7	70.0	0.76	0.47	9.0	0.32	0.21	18.7	20.29	12.55	2.40	45
1,300	1.0	25.4	55.8	0.53	0.28	7.6	0.22	0.19	14.2	9.22	2.20	1.90	45
1,300	1.5	26.1	59.7	0.59	0.33	7.9	0.24	0.19	15.6	9.22	3.43	2.00	46
1,300	2.0	26.2	64.0	0.65	0.39	8.0	0.26	0.20	16.8	9.22	4.71	2.20	46
1,400	1.0	26.8	55.8	0.50	0.28	7.5	0.21	0.19	15.0	9.75	2.33	2.00	48
1,400	1.5	27.6	59.7	0.59	0.33	7.7	0.23	0.19	16.5	9.75	3.63	2.10	49
1,400	2.0	27.7	64.0	0.65	0.39	8.0	0.25	0.20	17.8	9.75	4.98	2.20	49
1,500	0.0	25.2	48.4	0.41	-	6.9	0.20	0.20	12.2	10.26	-	1.70	45
1,500	1.0	28.3	55.8	0.53	0.28	7.4	0.21	0.19	15.8	10.26	2.45	2.10	50
1,500	1.5	29.0	59.7	0.59	0.33	7.6	0.22	0.19	17.3	10.26	3.82	2.20	51
1,600	0.0	26.5	48.4	0.41	-	6.9	0.19	0.20	12.8	10.77	-	1.80	47
1,600	1.0	29.7	55.8	0.53	0.28	7.3	0.22	0.19	16.6	10.77	2.57	2.20	53
1,600	1.5	30.4	59.7	0.59	0.33	7.4	0.22	0.20	18.2	10.77	4.01	2.30	54
1,700	0.0	27.7	48.4	0.41	-	6.8	0.21	0.21	13.4	11.28	--	1.90	49
1,700	0.5	29.6	52.0	0.47	0.22	7.0	0.20	0.19	15.4	11.28	1.26	2.10	52
1,800	0.0	28.9	48.4	0.41	-	6.8	0.21	0.21	14.0	11.77	--	2.00	51
1,800	0.5	30.9	52.0	0.47	0.22	7.0	0.20	0.20	16.1	11.77	1.31	2.20	55
1,900	0.0	30.1	48.4	0.41	-	6.8	0.21	0.21	14.6	12.26	--	2.00	53
1,900	0.5	32.2	52.0	0.47	0.22	6.9	0.20	0.20	16.8	12.26	1.37	2.20	57
2,000	0.0	31.3	48.4	0.41	-	6.8	0.21	0.21	15.2	12.74	--	2.10	55
2,100	0.0	32.5	48.4	0.41	-	6.8	0.22	0.22	15.7	13.21	--	2.20	58

[1]For bulls that are at least 12 months of age and weigh more than 50% of their mature bodyweight (2,000 lb mature bodyweight).
[2]Adapted from the 1986 and 1996 Nutrient Requirements of Beef Cattle.

time frame will allow bulls to moderate their fat cover and "harden up," likewise thin bulls will have adequate time to increase their body condition if required. Additionally, the 60-day time frame provides adequate time for the sperm population to turnover and quality sperm to develop prior to the bull entering breeding service. The bull should enter the breeding season in a body condition score of 5.5 to 6.5 (9 point scale). This body condition score provides the bull adequate body reserves to draw upon during the defined breeding season. The nutrient requirements to support the moderate growth and maintenance of the bulls during this period are listed in Table 1.

Nutrition during the breeding season

The nutritional environment during this period is almost always the same as the cow herd. Therefore special nutritional attention for bulls is nearly impossible. As a result, the conditioning period prior to initiation of the breeding season becomes all the more important. Bulls during the breeding season can lose from 100-400 lbs of bodyweight which equates to a loss of 1 to 4 units of body condition score. The amount of bodyweight and body condition loss will be influenced by the age of the bull, prior body condition, length of the breeding season, level of activity experienced by the bull, and breed type of the bull. Young bulls and terminal sire type bulls in the Florida environment will likely lose more body weight and condition during the breeding season compared to older or maternal type bulls in the Florida environment.

Nutrition after the breeding season

The bulls after the breeding season likely will need some attention to restore their bodyweight and body condition. The amount of bodyweight and body condition that needs to be replaced after the breeding season can be considerable depending upon how much bodyweight and body condition the bull mobilized. A 2,000 lb bull that loses 200 lbs could require up to 1,200 lb of 65% TDN feed to fully regain all of the bodyweight that was mobilized. As mentioned previously young bulls and terminal sire type bulls likely will lose more bodyweight. Greater the bodyweight loss by the bull will result in greater amounts of nutritional inputs that will be required to regain bull bodyweight. The length of the breeding season and length of the resulting recovery period will dictate the intensity of feeding to recover the lost bodyweight. Maternal sire type bulls are likely to be expected to regain bodyweight on pasture alone or with minimal supplemental feed. Terminal sire type bulls may require supplemental feeds to regain lost bodyweight because pasture quality may not support the needed performance. Likewise the use of young bulls that still have growth requirements will likely result in greater feed input requirements after the breeding season. The nutrient requirements for gain of growing and mature bulls are listed in Table 1.

Feedstuff Considerations

"What are good feeds to feed, develop, and manage bulls?"

Feedstuff selection for feeding bulls should be based upon the necessity of meeting the nutrient requirements of the growing bull and the unit/price of the important nutrients (energy, protein, minerals). For growing bulls energy is most likely the nutrient that limits growth, thus feedstuffs that contain adequate energy concentrations to support the desired level of growth should be consider. In most cases energy-dense feedstuffs will be some type of cereal grain or co-products (corn, oats, corn gluten feed, dried distillers grains). Fiber based energy supplying co-products are also acceptable feed choices (soybean hulls, citrus pulp). Cattle have been reported to over consume soybean hulls in self-feeding scenarios with cattle incurring bloat problems and possible death. Self-feeding of any feedstuff without proper management practices in place and knowledge of feed intake patterns should be avoided.

Protein feeds can consist of any of the oilseed meals or selected co-products (soybean, cottonseed or dried distillers grains, corn gluten feed). The utilization of urea in formulated diets or pre-formulated protein supplements may be an economical source of nitrogen if the diet contains adequate energy. Similarly, the need for roughage in the diet may necessitate the use of medium to good quality forages to support the desired growth level. The digestible protein in good quality forages can help offset the need for very high

Table 2. Example bull growing diet and transition diets.

	Bull bodyweight, lbs			
Feedstuff	1,000	1,100	1,200	1,300
	%DM included in total diet			
Bahiagrass hay	45	55	65	75
Shelled corn	30	20	10	0
Soybean hulls	20	20	20	20
Protein co-product[1]	5	5	5	5
Limestone	0.1	0.1	0.1	0.1
TDN, %	71	67	63	59
NE_M, Mcal/lb	0.72	0.66	0.61	0.55
NE_G, Mcal/lb	0.45	0.40	0.35	0.31
CP,%	13.3	13.5	13.6	14.0
DMI, lb	20	24	28	32
ADG, lb/d[2]	2.16	2.22	2.15	1.97

[1]Corn gluten feed, dried distillers grains, soybean meal, or cottonseed meal are all nearly equally effective in this role relative to ADG.
[2]Average daily gains will increase at each bodyweight for each diet with increasing dry matter intake.

inclusion levels of protein concentrates.

A variety of roughage sources are fully acceptable as ingredients for bull rations. The selection of any particular roughage option will depend upon the age, bodyweight, and growth requirements of the bull. Common roughage sources include bermudagrass and bahiagrass hay. The selection of hay should be based upon the performance goals for the bull with the objective of meeting the nutrient requirements. Silage from either corn or sorghum is also a great roughage source for feeding bulls. Silage is particularly useful during the development phase and can have application during the transition phase. Obviously, pasture is a primary choice for roughage in a bull diet. When pasture is utilized a number of issues need to be considered including adequate pasture forage availability, adequate forage intake, and acceptable forage quality to meet the feeding goals. An often over-looked consideration in allocating pasture for bulls is the difference in forage intake compared to cows. Bulls, in some cases can be 1.5-2.0 times as large as cows. Additionally, developing or reconditioning of bulls need higher quality pasture, and thus the opportunity to select higher quality pasture. Thus bulls may need to be stocked at 1.5 to 3.0 times the land area of a cow. Winter pasture would be a particularly good choice as a forage source in bull rations. Winter pasture is generally high in both crude protein and total digestible nutrients (TDN) which can go a long way to meeting the nutrient requirements for growing and maintenance bulls.

"What about whole cottonseed and the gossypol issue?"

Whole cottonseed (WCS) may be the one feed resource that needs to be utilized with a measure of caution for feeding bulls, particularly growing bulls. Velasquez-Pereira et al. (1998) determined that feeding 31 mg of free gossypol/lb of bodyweight/day (6 to 14 lbs of WCS) to growing bulls from 6 to 16 months of age resulted in increased sperm abnormalities, decreased sperm production, and adversely affected measured aspects of bull sexual behavior. The use of WCS for young bulls should be limited to 10% or less of the total diet (Boyles).

When feeding more mature bulls, the use of WCS may be an acceptable feedstuff for the majority of the year. An acceptable recommendation is that bulls are moved off of WCS at least 90 days prior to the initiation of the breeding season. Excluding WCS from the diet of bulls will ensure that there is an opportunity for the sperm present in the testes to be turned over. The 90-day removal will allow adequate time for the gossypol to be metabolized and sperm production to occur without the potential negative influence of gossypol. In many production systems, the cow herd

Table 3. Effect of diet dry matter intake on bull bodyweight gain.[1]

	Bull bodyweight, lbs			
Estimated DMI, lb	1,000	1,100	1,200	1,300
	Predicted ADG, lb/d			
20	2.16			
22	2.58	1.87		
24	2.98	2.22		
26	3.39	2.57	1.86	
28	3.79	2.91	2.15	1.49
30	4.18	3.25	2.44	1.73
32		3.58	2.72	1.97
34		3.91	3.00	2.21
36			3.28	2.44
38				2.68

[1]Diets as formulated for each bodyweight in Table 2.

is supplemented with WCS during the breeding season so bulls are exposed to WCS and the effects of gossypol. The level of exposure will be dictated by the level of supplementation and potential level of WCS consumption by the bulls.

"What should the mineral program be – Organic or Inorganic?"

The general answer is yes; both organic and inorganic may be utilized effectively as mineral sources for bull development. Regardless of the choice to include organic sources or not, the use of well-balanced mineral and vitamin supplement to meet the bull's requirements is the main management consideration. The uses of organic minerals that may result in the greatest benefit include: zinc, selenium, and copper. Arthington et al. (1995) reported increased fertility measures for bulls offered organic zinc, however elevated concentrations of inorganic zinc were just as effective as the organic sources. The authors did indicate that the recommended level of 30 ppm in the diet (NRC, 1996) was likely too low to benefit. Selenium is also implicated in sperm viability, quality, and overall reproductive health.

The year-round use of organic minerals for bull production is not necessary. Similar to the overall conditioning period, the use of organic minerals should be implemented 60-90 days before initiation of the breeding season. The advanced time-frame allows for the turnover of sperm that may have been affected by any transient mineral deficiencies. The use of organic mineral supplementation can be continued into the breeding season if the cow herd is also being supplemented with organic mineral sources and it is believed that the bull will consume the mineral. Outside of the conditioning period and early breeding season the use of organic minerals is not likely warranted. What is important is to provide the bulls the same mineral supplementation program that any productive member of the beef herd should have. Ignoring the bull's mineral needs the other 275 days of the year is not sound management and will likely lead to longevity issues for the bull.

Transition Time-frame Considerations

As mentioned previously, the transition of a purchased bull from a test diet to a normal production type diet is critical. An assessment of the bull's previous level of nutrition and its characteristics on his current and future performance needs to be made. Often bulls come off of test diets rather well conditioned (i.e. fat, body condition score of 7+). While that conditioning may have been appealing in the sale ring, it will not be that great of an asset breeding cows on the ranch. How fat is the bull and how much fat needs to be shed and replaced by lean muscle is the issue. Excessive condition can be detrimental to semen quality because fat deposition decreases the effective cooling of the testes. Likewise excessive condition going into the breeding season can set the bull up for failure as the

increased activity level and reduced feed intake cause him to "melt" as the breeding season progresses. Therefore, the goal of the transition period should be to adapt "let down" the new bull from a high-energy concentrate diet to a low- to moderate-energy, roughage based or grazing diet over time, continue the growth pattern as needed, and adapt the bull to an elevated activity level.

The transition between diets should occur over several weeks to provide adequate time for the bull to adapt to the new diet. In that regard, the bull will need to receive a diet not that different from the test diet when he arrives at the ranch. A supply of similar concentrate feedstuffs will need to be on hand for the bull upon arrival. The transition at the ranch could begin with a diet that contains 60-70% of the previous concentrate intake and then be decreased gradually over a number of weeks until the final diet formulation is reached. Therefore it is imperative that planning go into the purchase, nutrition, and overall management of a bull prior to his use during the breeding season. Replacement of the concentrate portion of the ration can be replaced by bulky, fibrous feedstuffs (soybean hulls, citrus pulp) or replacement with moderate quality hay or silage. Remember, young bulls still have a growth requirement and likely still need to gain 2.0 to 2.5 lbs/day of bodyweight during the transition. Therefore, depending upon the quality of the forage base utilized, complete removal of the concentrate portion of the diet may not be completely feasible. The concentrate portion of the ration generally supplies the energy and most of the protein to meet the bull's growth requirement. Some example rations are presented in Table 2.

The bodyweight gains of bulls during the transition period is dependent upon a number of factors that include previous bodyweight gain, current bodyweight, current body condition, and desired bodyweight at the initiation of the breeding season. Gain achieved is then determined by dry matter intake and diet energy and protein density (Table 3). Bulls that are undersized for their desired breeding season bodyweight will need to be developed during the transition period at a greater rate of bodyweight gain compared to more fully developed bulls. In contrast, bulls that are overly conditioned but are not fully mature still require a positive plane of nutrition; albeit one that emphasizes lean bodyweight gain rather than fat deposition. To that end, rations that are high in roughage content or utilize quality pasture, moderate the readily available carbohydrate concentration, and provide adequate protein are desirable.

Another important consideration during the transition period is exercise. Likely, bull test animals came out of confined spaces/pens and are not acclimated to open space. Provide the bull adequate space to exercise and become accustom to a level of exercise. If the pasture size is adequate in size; water, feed, and mineral can be spread around the pasture to encourage a level of activity prior to the breeding season. An increased level of activity may increase the bull's nutrient requirements by 5-10%, so appropriate consideration should be given.

Conclusions

Key nutritional time frames exist in the lifespan of the bull in the beef herd. The appropriate nutritional management of growing bulls is a key component to the long-term reproductive success of the beef cow herd. Like much of the management of beef cattle, the transition periods are management situations that can have significant effects on the success of the bull management program. During the transition periods, the prior nutritional status, current body condition, and bodyweight growth goals of the bull all need to be considered when designing a bull nutrition management program.

Literature Cited

Arthington, J. D., K. R. Johnson, L. R. Corah, C. L. Williams, D. A. Hill. 1995. The effect of dietary zinc level and source on yearling bull growth and fertility. Cattlemen's Day, Report of Progress, Page 115. Kansas State University, Manhattan, KS.

Boyles, S. Bull nutrition and management. http://beef.osu.edu/library/bullnutr.html. Accessed March 10, 2008.

NRC. 1996. Nutrient requirements of beef cattle. National Academy Press, Washington, DC.

Velasquez-Pereira, P. J. Chenoweth, L. R. McDowell, C. A. Risco, C. A. Staples, D. Prichard, F. G. Martin, M. C. Calhoun, S. N. Williams, and N. S. Wilkinson. 1998. Reproductive effects of feeding gossypol and vitamin E to bulls. J. Anim. Sci. 76:2894-2904.

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