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Rations for Bulls on Performance Test

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Bulls fed in the University of Missouri Central Testing Station receive a break-in ration for 21 to 28 days prior to the official 140-day feeding test. The break-in ration contains 60% concentrate compared to 80% concentrate in the ration used for the 140-day official test period (Table 2).

The purposes of the break-in period are to allow the cattle to recover from the stress of handling and being placed in a new environment, to bring them to a full-feed of a high energy ration, and to partially equalize the fleshing and gut fill of the bulls from different herds and management when they are weighed to start the official rate-of-gain test.

A high energy ration with 20% roughage is self-fed during the official test. A ration with this level of concentrate has ample energy to allow the animals to fully express genetic differences for rate of gain. Also, this ration has energy and concentrate levels typical of finishing rations that are fed to most of the cattle finished for slaughter in commercial feedlots.

On-Farm Tests

Many breeders who are feeding bulls on their farm to qualify for the Missouri performance-tested bull sale feed the ration used at the central test station. Other breeders are using rations that have some modification of the official test ration. Roughages and concentrates that can replace those used in the test ration will be discussed.

Starting on Feed

An animal has a daily requirement for protein, energy, and other nutrients instead of a certain percent of a nutrient in the ration. The amount of feed eaten daily determines the percentages of these nutrients that are needed in the ration. Cattle that are highly stressed or those that are not accustomed to a particular ration will usually eat less feed at first. Low feed intake is why starter rations for stressed cattle need high levels of protein, energy, minerals and vitamins to supply the cattle's daily nutrient needs.

A way to start cattle on feed with a minimum of digestive disturbance is to start with a high roughage ration and gradually add grain for 14 to 21 days. A practical way to start young bulls on feed would be to give them a full feed of good quality grass hay with two pounds of a 30 to 40% protein supplement per head daily. The supplement should furnish 25,000 I.U. of vitamin A and minerals needed to supplement the hay in supplying the daily nutrient requirements. If good legume hay is used, the protein supplement should be reduced to one pound per head daily during the period when bulls are brought to a full feed of grain.

If bull calves that have been on a creep ration are being fed at home, they can be switched immediately to the self-fed 40% roughage ration for the break-in period. After 14 to 21 days these bulls can be switched to the 20% roughage ration.

The following rations and procedures are used for the break-in and official test periods at the University of Missouri Central Test Station (Tables 1 & 2).

Feeding Recommendations

1. First day—full feed of grass hay plus 2 lbs of 30-40% protein supplement.
2. Continue to feed long hay free-choice and increase grain at the rate of ½ lb per head daily until cattle are eating 1 lb of concentrate (grain + protein supplement) per 100 lbs of body weight. This will take 10 to 14 days.
3. When cattle are eating 1 lb of concentrate per 100 lbs of body weight give them access to a self-feeder filled with a 40% roughage ration (ration #1), with long hay fed free-choice. Keep on this ration for 10 to 14 days.
4. When official test begins, change to 20% roughage ration (ration #2), in self-feeder and remove long hay.
5. Feed Aureo S-700 or a similar medicated supplement during the 21 to 28 day break-in period.

Table. 1. Break-In Period

	Ration #1 (40% Roughage)							
	Lbs	DM	C.P.	TDN	Fiber	Ca	P	K
Shelled corn	740	636	63.6	592.0	15	0.15	2.00	2.09
Soybean meal	325	289	148.0	234.0	20	1.04	2.17	6.40
Wet molasses	110	83	3.3	59.4	-	0.98	0.09	2.61
Alfalfa meal (17%)	150	139	25.5	87.0	36	2.00	0.36	3.74
Cottonseed hulls	650	587	25.3	240.5	279	0.91	0.65	4.94
Limestone	6	6	-	-	-	2.10	-	-
Dicalcium phosphate	9	8	-	-	-	2.00	1.62	-
Trace mineral salt	10	9	-	-	-	-	-	-
Total	2000	1757	265.7	1212.9	350.0	9.18	6.89	19.78
% (as fed)		88	13.3	60.6	17.5	0.46	0.35	0.99
% (DM)		100	15.1	69.0	20.0	0.52	0.39	1.12

Vitamin A, 4 million I.U./Ton; feed aureo S-700® to supply 70 gm/Ton of auermomycin and .0077% sulfamethazine.

Table 2. Official 140-Day Test

	Ration #2 (20% Roughage)							
	Lbs	DM	C.P.	TDN	Fiber	Ca	P	K
Shelled corn	1242	1068	106.8	994.0	25	0.25	3.48	3.35
Soybean meal	270	240	121.5	194.4	16	0.86	1.81	5.32
Wet molasses	60	45	1.9	32.4	-	0.53	0.05	1.42
Alfalfa meal (17%)	100	93	17.0	58.0	24	1.33	0.24	2.49
Cottonseed hulls	300	270	11.7	111.0	129	0.43	0.27	2.28
Limestone	13	12	-	-	-	4.55	-	-
Dicalcium phosphate	5	5	-	-	-	1.11	0.90	-
Trace mineral salt	10	9	-	-	-	-	-	-
Total	2000	1742	258.9	1389.8	194	9.06	6.75	14.86
% (as fed)		87	12.9	69.5	9.7	0.45	0.34	0.74
% (DM)		100	14.9	79.8	11.1	0.52	0.39	0.85

Vitamin A, 3 million I.U./Ton. Antibiotics, 3.5 mg/lb feed.

Ration Specifications

Protein.

Use natural proteins, such as soybean meal and cottonseed meal, instead of urea to supply the supplementary protein in bull-testing rations. Plant proteins usually give faster daily gain than urea when used to supplement corn silage and grain rations for cattle weighing under 700 lbs.

Urea is a cheaper source of protein equivalent than soybean meal and often will decrease the cost of feedlot gains. However, top performance is your primary goal with these test rations and using plant protein supplements throughout the test will likely maximize performance.

An exception would be the use of a combination of urea and distillers grain to supply by-pass protein. Studies have indicated this combination can be superior to soybean meal to supplement rations for young, growing cattle. The urea supplies ammonia in the rumen for microbes to build microbial protein. The protein in the distillers grain is less soluble in the rumen than that in soybean meal and more of it by-passes the rumen to be digested in the small intestines.

Another way to supply more by-pass protein and increase the performance of cattle making growth gains is to treat soybean meal with formaldehyde or heat to decrease its breakdown in the rumen.

Notice the official test ration has approximately 15% crude protein on a dry matter basis (DM). Tests at Purdue University indicated protein levels up to 14% (DM) increased the daily gain of bulls under 550 lbs for the first 56 days when fed corn silage and 1.0% of their body weight in corn grain. Bulls fed rations with 14%

(DM) protein gained slightly faster than those fed rations with 12% protein in Kansas State University trials. Energy level is higher in the Missouri official test ration than was used in either of these studies. Higher energy rations will likely be consumed at lower levels and need a higher percentage of protein.

Vitamins

Vitamin A is the vitamin most likely to be deficient in rations fed to young bulls on Missouri farms. If there is no sun-cured legume hay in the ration, there may be a need for some vitamin D for bulls fed inside or those fed during cloudy, winter weather. Supply 25,000 to 30,000 I.U. of vitam A per head daily with the ration. A level of 3 million I.U. of vitamin A per ton of complete ration (1,500 I.U. per lb of ration) will furnish 25,000 to 35,000 I.U. of vitamin A daily during the test period. It is advisable to purchase a vitamin A supplement that contains vitamin D and perhaps vitamin E. Supplying 50 mg of vitamin E a head daily can be helpful to cattle on rations that have low roughage, heat-dried or high moisture grains, and marginal selenium levels.

Minerals

Young, rapidly growing animals need higher levels of minerals in their ration than do older animals that have a lesser portion of their gain consisting of growth. A larger percentage of minerals is needed in higher energy rations because of the lower intake needed to meet energy needs. The National Research Council (NRC) recommends the following mineral levels (DM) in an 85% concentrate ration for a 600-lb steer gaining 3 lbs daily:

Calcium %	*Phosphorus %*	*Potassium %*
0.46	0.35	0.60 - 0.80

These or higher levels of minerals should be maintained in bull-testing rations. Later in the test period when bulls are increasing in condition, somewhat lower levels of calcium and phosphorus would suffice. Notice the mineral levels in the central test station ration are slightly higher than the NRC percentage. Some overage of minimum requirements will compensate for feeds that supply less minerals than the average composition values that are used for the formulation.

The ration should have 1.0 to 1.5 times as much calcium as phosphorus. When dietary phosphorus is adequate, as much as a 4:1 ratio of calcium to phosphorus is not harmful.

Recent work has shown in some, but not other trials, that adding finely ground feeding limestone to increase the calcium to 1.0% of ration dry matter can increase starch digestion in high grain rations fed to cattle. It is thought calcium carbonate acts as a buffer to increase the pH in the small intestine and thereby increases the efficiency of the starch digestive enzyme, amylase. More work is needed before these high levels of calcium can be recommended for high grain rations since the response has been erratic.

It is a common practice to add 0.5% salt to feedlot rations. Cattle probably do not need over 0.25% salt in the dry matter content of their ration. The extra salt will increase urine flow and may give some protection against urinary calculi. Use trace mineral salt for a source of trace minerals.

High grain rations with poor quality roughages could be deficient in selenium, a trace mineral. It can be added to beef cattle rations up to 0.1 ppm of the ration dry matter. Salt containing selenium can be purchased but cannot be fed at a level that supplies more than 1 mg of selenium a head daily for beef cattle according to the Food and Drug Administration (FDA) regulations.

Finally, mix minerals in the ration to best insure that each animal will get its daily mineral needs. Cattle do a poor job of selecting those minerals needed to balance a deficient ration when minerals are offered individually, cafeteria style.

Free-choice mineral supplements are necessary in some situations where complete mixed rations are not fed. For best results, a free-choice mineral supplement should be formulated with the level of minerals needed to meet the deficiencies of the ration when the mineral supplement is eaten at a predicted level. Measure the daily intake of the mineral supplement and make adjustments in formulation to insure that mineral consumption is sufficient to supply the cattle's needs. Even when minerals are added to a complete mixed ration, some nutritionists advise that a simple mineral mixture, such as one composed of equal parts of plain salt and dicalcium phosphate be fed free-choice.

Grains

Milo, wheat, barley, and oats can be substituted for all or part of the corn in the test station bull rations. Corn is higher in energy than oats or barley, but is usually lower in protein than any of these grains. Substituting one of these grains for all the corn in the test station ration is apt to decrease the daily gain of the bulls. Do not replace over half of the corn with barley milo or wheat, or one-third of the corn with oats. Some decrease in roughage content can be made to keep energy and fiber levels similar when oats and barley are substituted for corn in a ration.

Roughage Levels

Ration #2 with 20% roughage has 11% crude fiber on a dry matter basis. Experimentation has indicated that high concentrate rations with enough roughage to supply 9 to 11% crude fiber give top performance in the feedlot and are relatively safe with digestive upsets minimized. However, rations with as much as 30 to 35% roughage have often been consumed at sufficiently higher levels to keep energy intake and rate of gain near maximum.

Cottonseed hulls are an ideal roughage for a test station ration because of their physical characteristics for mixing with pelleted feeds and the consistency of their nutrient composition from batch to batch. Ground corn cobs are another roughage with these same characteristics.

Roughages that can be used in place of cottonseed hulls or corn cobs include grain silages, forage silages, haylages, hays, cereal straws, fescue screenings, rice hulls, and sawdust. Some changes in formulation are necessary to maintain a similar nutrient concentration in the ration when other roughages are used in place of cottonseed hulls in Ration 1 or 2.

There are problems with replacing hulls or cobs with hay or straw in rations fed in self-feeders. Grinding or pelleting hay or straw causes it to lose much of its roughage value in a ration. Chopped hay or straw will bridge in a feeder. Sawdust is occasionally used as a diluent in high concentrate rations. Non-hydrolyzed, oak sawdust has no nutritional value for cattle. The sawdust should be dry, relatively fresh, not rotten, and of a coarse particle size if it is used as a roughage factor in high grain rations.

Special Considerations

Antibiotics

Feeding 500 to 700 mg of antibiotics per head daily for the first 21 to 28 days to cattle being placed on feed has increased performance and reduced sickness and death loss in the starting period in many studies. Feeding Aureo S-700® for the first 28 days of the feeding period has given the foregoing results. This additive is fed at a level to supply 350 mg of aueromycin and 350 mg of sulfamethazine a head daily for a maximum of 28 days. After 28 days the antibiotic in the ration should be reduced to 60 to 100 mg a head daily for continuous, low-level feeding.

Be sure to check the level of continuous feeding allowed by the Food and Drug Administration (FDA) for the antibiotic you are using. Antibiotics in the ration decrease the incidence of liver abscesses which are sometimes a problem with high concentrate rations. Cattle with liver abscesses have reduced performance. A summary of numerous university trials indicates that the low level feeding of a broad spectrum antibiotic to feedlot cattle has increased rate of gain and feed efficiency an average of 3 to 4%.

Buffers

Buffers are added to beef cattle rations to prevent below normal rumen pH and the development of lactic acid acidosis that sometimes occurs in cattle. Acidosis is most likely to occur when cattle are started on high concentrate rations, when ration changes are made, and when high silage rations are fed, since silages have high levels of organic acids. Sodium bicarbonate is a "buffer" that is most often used in beef rations. Others used include limestone, dolomite, magnesium oxide and sodium bentonite. Strictly speaking, these are not buffers but acid neutralizers that aid in maintaining the rumen pH near an optimum level.

No clear conclusion can be made from research results on the use of supplemental buffers in cattle rations. Buffers are most likely to be of value during adaptation to high concentrate rations and when high silage or wheat rations are fed.

Levels of sodium bicarbonate usually recommended for beef cattle are 15 lbs per ton of total air dry ration (0.75%) during the first half of a finishing period and reduced to 5 lbs per ton (0.25%) of the total ration during the last half. This is equivalent to 2 to 3 ounces of sodium bicarbonate (55 to 85 gm) per head daily during the first half of the feeding period and one ounce (28 gm) during the second half. You may want to discontinue the buffer after the first half of the test period.

Rumensin® is an additive that improves feed efficiency by 8 to 10% but gives no improvement in daily gain for cattle on high grain rations. Rumensin® is not presently approved by FDA for inclusion in the ration of breeding animals.

Bulls to be kept for breeding should not be implanted with Ralgro® or Synovex®. These implants are not cleared by FDA for breeding animals. Also, Ralgro® implants have been shown to retard the development of testicles in bull calves.

Processing

The supplements and alfalfa meal in rations 1 and 2 are pelleted before mixing with the cracked corn and cottonseed hulls for self-feeding at the University of Missouri Central Test Station. A properly made pellet can reduce the fineness and dustiness of a ration and maintain a uniform mixture of ingredients.

Grinding, rolling, and steam rolling appear to give similar results for grains fed to cattle. High moisture storage and heat treatments like steam flaking improve the feed value of milo (8 to 12%) more than they improve corn (4 to 8%).

Milo and wheat must be processed for cattle rations. Fine grinding or rolling is superior to coarse grinding or rolling for milo.

Corn and wheat should not be ground too finely because of the problem with dust and palatability. Fine grinding does not give the improvement in digestion with these grains that is true of milo.

Whole shelled corn has given equal or slightly better results than rolled or ground corn when fed to cattle in rations that contain less than 20% roughage (DM).

Cane or *beef molasses* can serve as a binder to decrease fine particles and hold the ingredients of a ration together. Molasses can also improve the palatability of some rations. It is a good source of potassium. Hold the level of molasses in the ration to 7% or less.

Too much molasses can decrease the digestibility of other feeds, especially roughages.

Silage Ration

Some cattlemen wish to feed a silage ration to bulls on performance test. Ration #3 uses excellent corn silage for roughage to furnish a ration that has similar nutrient composition to the official test Ration #2. A ton mixture for the concentrate portion of the ration is given with the ratio of concentrate to silage that must be fed to completely furnish Ration #3.

Feeding Instructions

1. Complete mixture—mix 725 lbs of concentrate with 1,275 lbs of (33% DM) corn silage (100 lbs concentrate to 176 lbs corn silage).
2. Make allowance for silages with other dry matter levels. Do this by dividing 33% by percent dry matter in silage to be fed and multiplying dividend by 1,275 to find pounds of silage to mix with 725 lbs of concentrate. (Example: 33 ÷ 40 = 0.825; 0.825 x 1,275 = 1,052 lbs)

Table 3. Bull Testing Ration Using Corn Silage

	Ration #3							
	Lbs	Dry Matter Lbs	Protein Lbs	TDN* Lbs	Crude Fiber Lbs	Ca Lbs	P Lbs	K Lbs
Corn silage (33% DM)	1275	420.8	34.1	295	103	1.13	0.84	4.2
Corn	540	464.4	46.4	422	11	0.09	1.39	1.4
Soybean meal	168	150.0	76.5	121	10	0.54	1.12	3.3
Trace Mineral salt	4.5	4.0						
Dicalcium Phosphate	4.5	4.0				0.95	.81	
Limestone	7.0	5.5				2.45		1.8
Vitamin & Antibiotic Mix	1.0	.9						
	2000	1049.6	157.0	838	124	5.16	4.16	10.7
			Nutrient Content					
% (DM)**		100.0	15.0	79.8	11.8	.49	.39	1.02

Mixing Instructions

1. Make following concentrate mix (2,000 lbs)

	Lbs
Corn	1490
Soybean meal	463
Trace mineral salt	12.5
Dicalcium phosphate	12.5
Limestone	19.5
Vitamin & Antibiotic Mix	2.5
	2000

2. Add 14 grams of antibiotic per ton of concentrate (aureomycin, Tylan, bacitracin, etc.).

   Add 4 million I.U. of vitamin A per ton of concentrate. These are added at a level to supply approximately 80 mg of antibiotic per head daily and 3,000 I.U. of vitamin A per 100 lbs of body weight of cattle.

*Total digestible nutrients **(DM) = on dry matter basis

Table 4. Ration Using Corn Cobs

	Ration #4							
	Lbs	DM*	CP	TDN	Fiber	Ca	P	K
Shelled corn	1232	1060	106.0	986.0	25.	0.25	3.45	3.33
Soybean meal	280	252	126.0	202.0	16.0	.90	1.87	5.51
Wet molasses	60	45	1.9	32.4	-	0.53	0.05	1.42
Alfalfa meal (17%)	100	93	17.0	58.0	24.0	1.33	0.24	2.49
Corn cobs	300	271	7.5	126.0	97.2	.33	.12	2.28
Limestone	13	12	-	-	-	4.55	-	-
Dicalcium phosphate	5	5	-	-	-	1.11	.90	-
Trace mineral salt	10	9	-	-	-	-	-	-
Total	2000	1747	258.4	1404.4	162.2	9.0	6.63	15.03
% (as fed)		87.3	12.9	70.2	8.1	.45	.33	.75
% (DM)*			14.8	80.4	9.3	.51	.38	.86

*DM = dry matter

Corn Cob Ration

Corn cobs are substituted for cottonseed hulls with minor changes in soybean meal and other ingredients to supply the same nutrient levels contained in Test Station Ration #2 (Table 4).

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