FACT SHEET 1097—For Beef Manual

MICHIGAN BEEF PRODUCTION

Cooperative Extension Service ⋘ Michigan State University

Summary of Nutrient Requirements for Growing and Finishing Cattle

Danny G. Fox, Beef Specialist
Animal Husbandry and
J.R. Black, Extension Economist
Agricultural Economics

Nutrient requirements and expected dry matter intakes for steers and heifers fed corn-corn silage rations are summarized in this fact sheet. Detailed discussions of individual nutrient requirements are given in Fact Sheet 1010, "Energy Utilization by Cattle and the Use of Energy Values in Ration Formulation;" Fact Sheet 1011, "Net Energy Requirements of Growing and Finishing Cattle;" Fact Sheet 1060, "Vitamin Requirements of Beef Cattle;" and Fact Sheet 1080, "Mineral Requirements of Beef Cattle."

This fact sheet is used in conjunction with Fact Sheet 1102, "Feed Composition Values; "Fact Sheet 1200, "Formulating Rations for Growing and Finishing Beef;" and Fact Sheet 1210, "Beef Ration Formulation by Computer," for evaluating and balancing rations. Energy, protein, calcium, and phosphorus requirements are summarized in Table 1. The requirements are categorized according to an animal's weight and the amount of corn fed/head/day. Potassium and salt requirements are given in Table 2, Vitamins A, D, and E requirements in Table 3, and sulfur requirements in Table 4. The requirements given here were used to develop Fact Sheet 1204, 1204A and 1204B "Protein-Mineral Supplements for Corn-Corn Silage Rations."

WEIGHT GROUPINGS

All weight groupings are referenced to an average framed steer, one that will reach a fatness of low choice at a weight of 1050 to 1100 lbs. The term *equivalent weight* is used to summarize weights at which animals of differing frame sizes are equivalent in body composition -- hence, nutrient requirements. Small framed steers are defined as those reaching a fatness of low choice at 800 to 880 lbs., while large framed steers reach that point at 1200 to 1320 lbs. Small framed heifers reach low choice at 660 to 720 lbs., average framed at 800 to 880 lbs., and large framed at 940 to 1030 lbs.

We use, in Table 1, the term *ration* to describe particular combinations

of rates of corn fed/day and equivalent weight. All animals within a particular grouping have similar nutrient requirements.

Consider an example. Rations 4-6 in Table 1 are for animals with nutrient requirements comparable to 600 to 700 lb. average framed steers. Cattle ranging from 385 to 450 lb. small framed heifers up to 720 to 840 lb. large framed steers are included in this equivalent weight category.

Five weight groupings are used in summarizing nutrient requirements. Rations 1-3 are for equivalent weights of less than 600 lbs.; rations 4-6 are for 600 to 700 lbs.; rations 7-10 are for 700-800 lbs.; rations 11-14 are for 800 to 900 lbs.; and rations 15-18 are for 900 lbs. to market weight.

CORN/HEAD/DAY

Nutrient requirements are given for four rates of corn feeding. For feeders started as calves, corn/head/day at rates of 0, .6 to .7, and 1.4 to 1.5 lb./100 lb. of body weight, dry corn equivalent, are considered for equivalent weights up to 700 lbs. A finishing ration, corn at the rate of 1.8 to 1.9 lb./100 lb. of body weight, dry corn equivalent, is given for equivalent weights above 800 lbs. Since feeders started as yearlings typically eat more dry matter/day at a given weight than calves, the cattleman must feed corn as a larger percent of body weight to obtain the same energy/lb. dry matter. The equivalent rates for yearlings are 0, .65 to .75, 1.55 to 1.65, and 2.0 to 2.1 lb./100 lb. of body weight.

Consider an example. Ration 6 is for an equivalent weight of 600 to 700 lbs. It summarizes the protein, calcium, and phosphorus requirements when an animal within that weight group is fed dry corn at the rate of 1.4 to 1.5 lb./100 lbs. of body weight/day, or 9.5 lbs. for a 650 lb. average framed steers. Protein required is 13.0% of ration dry matter.

DRY MATTER INTAKE AND GAIN PROJECTION

Expected dry matter intakes are given for each equivalent weight group. The resultant expected daily gains for a given rate of corn feeding are calculated. All gain projections are based upon feeders purchased in average flesh condition, fed in a stress-free environment, and receiving a growth stimulant. Fact Sheet 1098, "Performance Adjustment Factors for Frame Size, Degree of Fleshiness of Purchased Feeders, Use of Growth Stimulants, and Environment," can be used to adjust the gain projections to your system. Fact Sheet 1212, "Expected Dry Matter Intakes for Growing and Finishing Cattle," discusses factors influencing intake and the impact on performance and profitability of below normal feed intakes.

ADJUSTMENT FOR FEEDING RUMENSIN

Rumensin is a feed additive for beef cattle that improves feed efficiency by increasing the energy available from a given amount of ration. Daily dry matter intake is reduced approximately 10% when Rumensin is fed at the recommended rate and daily gains are unchanged, resulting in a 10% reduction in feed requirements.

Due to the reduction in dry matter intake and no change in daily gain, some changes must be made in requirement values used to balance the ration.

Although the animal is eating 10% less, its daily protein, mineral and salt requirements in actual lbs. are the same because the rate of gain is unchanged. *Thus the percentages of protein, mineral and salt in ration dry matter given in Tables 1 and 2 must be 10% higher.* To do this, multiply the percentage requirement by 1.1 and multiply the expected dry matter intake by .9. The recommended level of feeding rumensin is 30 grams per ton of dry matter or 150 milligrams/head under 600 lb., 200 milligrams from 600 to 800 lb., and 300 milligrams/head/day to those over 800 lb., based on expected daily dry matter intakes.

However, the amounts of supplement to feed/head/day recommended in fact sheets 1204A and 1204B would not be greatly changed. By following those recommendations you are feeding the same amount of supplemental protein and minerals even though rumensin is fed and total ration dry matter intake is reduced.

ADJUSTING TABLE 1 FOR YEARLINGS

The nutrient requirements for yearlings, as a percent of ration dry matter, are similar to those for feeders started on feed as calves. However, at a given weight, yearlings typically consume 10% more dry matter/day than calves. This has two implications. First, to obtain the same energy/lb. of dry matter consumed, the rate of corn fed must be increased as noted earlier. Second, daily gains at a particular energy level are higher; they will run 15% to 20% higher than for calves.

NOTES ON REQUIREMENTS

Allowances were made, during the calculation of protein requirements, for protein quality differences among feeds and as influenced by method of storage. Consider the implications related to the rate of corn feeding. Total protein required, as a % of ration dry matter, is increased as the proportion of corn in the ration increases. Two forces influence that pattern. One one hand, as the rate of gain/day increases, the *biologically available* protein requirement/day for tissue growth increases. But, at the same time, the protein quality of corn is superior to that of silage so less total (crude) protein is required per unit of weight gain on high grain rations than on high silage rations.

The % total protein in fermented feeds such as ensiled high moisture corn and corn silage is of lower quality than that of dry grains and forages. The requirements in Table 1 include an adjustment factor to reflect wide use of higher fermented rations.

The only vitamins normally of concern in Michigan rations and A and D. Most Michigan rations are high in corn silage, which is usually high in carotene content. Cattle can convert carotene to Vitamin A. If feeding a high grain ration or if the silage does not have a good green color, feed 20,000 IU of Vitamin A/head daily. Cattle exposed to sunlight synthesize adequate quantities of Vitamin D. Cattle fed in confinement, however, should receive 2,000 IU of Vitamin D/head daily.

SOME APPLICATIONS

Example 1

A cattleman has a uniform set of average frame steer calves weighing 450 lbs. He plans to feed an all corn silage ration (properly supplemented) until the cattle reach 800 lbs., followed by a switch to a high corn grain finishing ration to market weight. He will use *rations 1, 4 and 7* in developing the growing ration. *Rations 14 and 18* will be used for the finishing ration. Protein and mineral levels are the only differences between *rations 1, 4, and 7* and between *rations 14 and 18;* energy required is the same for *rations 1, 4 and 7* and for *rations 14 and 18.*

Example 2

A cattleman examining Table 1 comments that he would prefer to switch protein-mineral feeding levels at 150 lb. increments as contrasted to the 100 lb. increments in the table. How should he proceed? If he had 450 to 500 lb. average frame steer calves, he might use *ration 1* to 650 lbs. followed by an average of *rations 4 and 7* from 650 lbs. to 800 lbs. If he were following a two-phase feeding system with a late switch from corn silage to high grain, these rations would be followed by *ration 14* from 800 lbs. to 950 lbs., and *ration 18* from 950 lbs. to market.

An important point to remember in evaluating how often you should change the rate at which supplement is fed is that while it is difficult to keep track of three or four supplements, it is relatively easy to change the amount of supplement fed/head/day. Usually, no more than two supplements are needed for the entire feeding period from 400 lbs. to 1050 lbs. One supplement formulation is adequate for many feeding systems. But, it would seem to be wise to change the amount of supplement fed/head/day as often as is practical and consistent with changing nutrient requirements, unless a fixed amount must be fed because a growth stimulant is being fed in the supplement. It is easy to spend $5 to $10 more per head than is warranted by over-supplementing. For a two-phase system, an individual will need a growing protein-mineral supplement and a finishing protein-mineral supplement. However, within each phase it will be reasonable easy to change the amount of supplement fed/head/day.

Example 3

A cattleman wants to see if a ration he is feeding to a pen of average frame steers which range in weight from 450 lbs. to 640 lbs. is properly balanced. He is currently feeding a lb./head/day of a 40% protein-mineral supplement that contains 4.5% calcium, .5% phosphorus, and 3.0% salt along with all the corn silage they will eat. He estimates they are eating 32 lbs. of silage/head/day.

He uses *Ration 1* as a reference point. First, is daily dry matter intake okay? Dry matter intake/head/day is:

1.0 lbs. supplement x (.90 lbs. DM/lb. supplement)	=	.9 lbs.
+ 32 lbs. silage x (.32 lbs. DM/lb. silage)	=	10.2 lbs.
TOTAL		11.1 lbs.

That is 83% of the typical intake of 13.4 lbs. given in Table 1. This suggests there may be a nutritional or health problem (See Fact Sheet 1212).

Now let's see if the ration balanced. Total (crude) protein/head/day is:

1.0 lbs. supplement x (.40 lbs. CP/lb. supplement)	= .40 lbs.
+ 10.2 lbs. silage DM x).08 lbs. CP/lb. silage DM)	= .82 lbs.
TOTAL	1.22 lbs.

That is 11% of dry matter -- on the low side. Similar calculations reveal that the ration dry matter contains .66% calcium, .20% phosphorus, and .27% salt. Calcium and salt are adequate. However, phosphorus is 60% of the recommended level. In summary, the ration is nutritionally inadequate -- too little protein is fed and the phosphorus level of the supplement is too low.

Example 4

A cattle feeder has cattle in the same pen ranging in weight from 600 lbs. to 800 lbs. What weight should he use in looking at Table 1? Typically, the cost of underfeeding protein and minerals is higher than the cost of overfeeding -- thus use a weight lighter than the average for the pen. Say, for example, 650 lbs. Or, to look at it differently, feed the appropriate ration until the average weight for the pen is beyond the *switch* weight.

TABLE 1. NUTRIENT REQUIREMENTS FOR CORN, CORN SILAGE RATIONS

Equivalent Weights	Ration #	Animal Description				Expected Daily		Corn, lb./100 lb. of body weight	Requirements			
		Sex	Age	Frame	Weight, lbs.	Dry matter intake, lbs.	Gain, lbs.		NE_g, Mcal/ lb DM	Total Prot. % DM	Cal. % DM	Phos % DM
T O 600 LBS	1	Heifer	Calf	Small	To 385	9.6	1.40-1.45	None	.45	13.0	.46	.34
				Average	To 480	11.3	1.65-1.70					
				Large	To 570	12.9	1.85-1.90					
		Steer	Calf	Small	To 480	11.3	1.65-1.70					
				Average	To 600	13.4	1.93-1.98					
				Large	To 720	15.2	2.15-2.20					
	2	Heifer	Calf	Small	To 385	9.6	1.67-1.72	.6-.7 dry .7-.8 wet	.51	13.5	.46	.34
				Average	To 480	11.3	1.95-2.00					
				Large	To 570	12.9	2.20-2.25					
		Steer	Calf	Small	To 480	11.3	1.95-2.00					
				Average	To 600	13.4	2.28-2.33					
				Large	To 720	15.2	2.55-2.66					
	3	Heifer	Calf	Small	To 385	9.6	2.00-2.05	1.4-1.5 dry 1.7-1.8 wet	.57	14.0	.46	.34
				Average	To 480	11.3	2.33-2.38					
				Large	To 570	12.9	2.60-2.65					
		Steer	Calf	Small	To 480	11.3	2.33-2.38					
				Average	To 600	13.4	2.70-2.75					
				Large	To 720	15.2	3.02-3.07					
600 TO 700	4	Heifer	Calf	Small	385-450	11.2	1.40-1.45	None	.45	12.0	.40	.28
				Average	480-560	13.3	1.65-1.70					
				Large	570-665	15.3	1.85-1.90					
		Steer	Calf	Small	480-560	13.3	1.65-1.70					
				Average	600-700	15.7	1.93-1.98					
				Large	720-840	17.9	2.15-2.20					
	5	Heifer	Calf	Small	385-450	11.2	1.67-1.72	.6-.7 dry .7-.8 wet	.51	12.5	.40	.28
				Average	480-560	13.3	1.93-1.98					
				Large	570-665	15.3	2.15-2.20					
		Steer	Calf	Small	480-560	13.3	1.95-2.00					
				Average	600-700	15.7	2.28-2.33					
				Large	720-840	17.9	2.55-2.60					
	6	Heifer	Calf	Small	385-450	11.2	2.00-2.05	1.4-1.5 dry 1.7-1.8 wet	.57	13.0	.40	.28
				Average	480-560	13.3	2.28-2.33					
				Large	570-665	15.3	2.55-2.60					
		Steer	Calf	Small	480-560	13.3	2.35-2.40					
				Average	600-700	15.7	2.70-2.75					
				Large	720-840	17.9	3.05-3.10					

Equivalent Weights	Ration #	Animal Description				Expected Daily		Corn, lb./100 lb. of body weight	Requirements			
		Sex	Age	Frame	Weight, lbs.	Dry matter intake, lbs.	Gain, lbs.		NE_g, Mcal/ lb DM	Total Prot. % DM	Cal. % DM	Phos % DM
700 TO 800	7	Heifer	Calf	Small	450-510	12.5	1.50-1.45	None	.45	11.0	.34	.26
				Average	560-640	14.8	1.65-1.70					
				Large	665-760	16.8	1.85-1.90					
		Steer	Calf	Small	560-640	14.8	1.65-1.70					
				Average	700-800	17.5	1.93-1.98					
				Large	840-960	19.9	2.15-2.20					
	8	Heifer	Calf	Small	450-510	12.5	1.67-1.72	.6-.7 dry .7-.8 wet	.51	11.5	.34	.26
				Average	560-640	14.8	1.93-1.98					
				Large	665-760	16.8	2.15-2.20					
		Steer	Calf	Small	560-640	14.8	1.95-2.00					
				Average	700-800	17.5	2.28-2.33					
				Large	840-960	19.9	2.55-2.60					
	9	Heifer	Calf	Small	450-510	12.5	2.00-2.05	1.4-1.5 dry 1.7-1.8 wet	.57	12.0	.34	.26
				Average	560-640	14.8	2.28-2.33					
				Large	665-760	16.8	2.55-2.60					
		Steer	Calf	Small	560-640	14.8	2.35-2.40					
				Average	700-800	17.5	2.70-2.75					
				Large	840-960	19.9	3.02-3.07					
	10	Heifer	Calf	Small	450-510	11.4	2.00-2.05	1.8-1.9 dry 2.2-2.3 wet	.63	12.0	.34	.26
				Average	560-640	13.5	2.33-2.38					
				Large	665-760	15.3	2.60-2.65					
		Steer	Calf	Small	560-640	13.4	2.35-2.40					
				Average	700-800	15.9	2.70-2.75					
				Large	840-960	18.1	3.02-3.07					
800 TO 900	11	Heifer	Calf	Small	510-575	13.5	1.35-1.40	None	.45	11.0	.28	.24
				Average	640-720	16.0	1.60-1.65					
				Large	760-860	18.2	1.80-1.85					
		Steer	Calf	Small	640-720	16.0	1.60-1.65					
				Average	800-900	18.9	1.85-1.90					
				Large	960-1020	21.5	2.10-2.15					
	12	Heifer	Calf	Small	510-575	13.5	1.68-1.73	.6-.7 dry .7-.8 wet	.51	11.0	.28	.24
				Average	640-720	16.0	1.90-1.95					
				Large	760-860	18.2	2.15-2.20					
		Steer	Calf	Small	640-720	16.0	1.90-1.95					
				Average	800-900	18.9	2.20-2.24					
				Large	960-1020	21.5	2.50-2.55					
	13	Heifer	Calf	Small	510-575	13.5	1.95-2.00	1.4-1.5 dry 1.7-1.8 wet	.57	11.0	.28	.24
				Average	640-720	16.0	2.25-2.30					
				Large	760-860	18.2	2.55-2.60					
		Steer	Calf	Small	640-720	16.0	2.25-2.30					
				Average	800-900	18.9	2.63-2.68					
				Large	960-1020	21.5	2.95-3.00					
	14	Heifer	Calf	Small	510-575	12.3	1.96-2.01	1.8-1.9 dry 2.2-2.3 wet	.63	11.5	.28	.24
				Average	640-720	14.6	2.25-2.30					
				Large	760-860	16.6	2.55-2.60					
		Steer	Calf	Small	640-720	14.5	2.25-2.30					
				Average	800-900	17.2	2.63-2.68					
				Large	960-1020	19.6	2.95-3.00					

Equivalent Weights	Ration #	Animal Description				Expected Daily		Corn, lb./100 lb. of body weight	Requirements			
		Sex	Age	Frame	Weight, lbs.	Dry matter intake, lbs.	Gain, lbs.		NE_g, Mcal/ lb DM	Total Prot. % DM	Cal. % DM	Phos % DM
900 TO MARKET	15	Heifer	Calf	Small	575-Mkt.	14.3	1.25-1.30	None	.45	11.0	.28	.24
				Average	640-Mkt.	16.9	1.45-1.50					
				Large	860-Mkt.	19.2	1.65-1.75					
		Steer	Calf	Small	720-Mkt.	16.9	1.45-1.50					
				Average	900-Mkt.	19.9	1.70-1.75					
				Large	1020-Mkt.	22.7	1.93-1.97					
	16	Heifer	Calf	Small	575-Mkt.	14.3	1.50-1.55	.6-.7 dry .7-.8 wet	.51	11.0	.28	.24
				Average	640-Mkt.	16.9	2.05-2.10					
				Large	860-Mkt.	19.2	1.97-2.02					
		Steer	Calf	Small	720-Mkt.	16.9	1.75-1.80					
				Average	900-Mkt.	19.9	2.05-2.10					
				Large	1020-Mkt.	22.7	2.30-2.35					
	17	Heifer	Calf	Small	575-Mkt.	14.3	1.80-1.85	1.4-1.5 dry 1.7-1.8 wet	.57	10.5	.28	.24
				Average	640-Mkt.	16.9	2.10-2.15					
				Large	860-Mkt.	19.2	2.35-2.40					
		Steer	Calf	Small	720-Mkt.	16.9	2.10-2.15					
				Average	900-Mkt.	19.9	2.45-2.50					
				Large	1020-Mkt.	22.7	2.75-2.80					
	18	Heifer	Calf	Small	575-Mkt.	13.0	1.80-1.85	1.8-1.9 dry 2.2-2.3 wet	.63	10.0	.28	.24
				Average	640-Mkt.	15.4	2.10-2.15					
				Large	860-Mkt.	17.5	2.30-2.35					
		Steer	Calf	Small	720-Mkt.	15.4	2.10-2.15					
				Average	900-Mkt.	18.3	2.45-2.50					
				Large	1020-Mkt.	20.7	2.75-2.80					

Table 2. POTASSIUM AND SALT REQUIREMENTS FOR GROWING AND FINISHING CATTLE

Potassium	.60% of DM
Salt	.25% of DM

Table 3. VITAMIN REQUIREMENTS FOR GROWING AND FINISHING CATTLE

	IU/lb. DM
Vitamin A	
Newly arrived feeder cattle	2000 to 3000
Cattle under heat stress	1500
Normal conditions	1000
Vitamin D	
Cattle in confinement	120
Vitamin E	10 - 25

Table 4. SULFUR

When nonprotein nitrogen products such as urea are mixed in a protein mineral supplement or added to corn silage prior to ensiling, it may be desirable to add inorganic sulfur to the ration to insure that the nitrogen:sulfur ratio is normal. The normal range is 10:1 to 15:1. One must be careful to not add more supplemented sulfur than needed, however, because high levels of sulfur in the ration will likely reduce intake.

A good rule-of-thumb is to add 3.5 lbs. of inorganic sulfur for every 100 lbs. of urea or 0.3 lbs. of inorganic sulfur for every 5 lbs. of anhydrous ammonia. The most commonly available, and usually least cost, source of sulfur is calcium sulfate. To meet the above sulfur levels, add 20 lbs. of calcium sulfate/100 lbs. urea or 37 lbs./100 lbs. of anhydrous ammonia.

The use of calcium sulfate to meet the sulfur requirement reduces the supplemental calcium requirements since calcium sulfate contains 20% calcium. As a consequence, for every 100 lbs. of calcium sulfate used, limestone can be reduced by 53 lbs.

Table 5. CALCIUM: PHOSPHORUS RATION

There should always be at least the same amount of calcium as there is phosphorus in the ration.

Table 6. USE OF NONPROTEIN NITROGEN (NPN) PRODUCTS

Cattle with equivalent weights under 600 lbs. perform better on natural protein sources than on NPN. Above that weight, NPN prodjcts usually give performance similar to natural sources of protein after cattle are started on feed. The NPN product must be well mixed in the ration.

IP-11;78-2M-UP

0-11108

Michigan State University Printing