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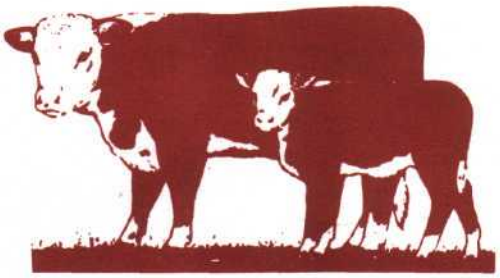

MICHIGAN BEEF PRODUCTION

COOPERATIVE EXTENSION SERVICE • MICHIGAN STATE UNIVERSITY

Formulating Rations for Growing and Finishing Beef

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Principles of Formulating Rations

The nutrient requirements of cattle depend on the rate of growth and weight of the cattle being fed. All the nutrients are interrelated and are generally required in proportion to each other. Thus it is uneconomical to feed quantities of any nutrient in excess of that required for maximum utilization of the most limiting nutrient. As energy and protein are the nutrients required in the greatest quantity and are the most costly, the amounts needed of each of these should be established first, and then the levels of minerals and vitamins should be added in the correct amounts to assure maximum use of the energy and protein.

For illustration, a two phase feeding program will be used here as it is one of the most popular and efficient systems. The first phase would be growing heifers to about 650 lb. and steers to 700 to 800 lb. on rations that will allow 1.8 to 2.2 lb. per day gain, and then gradually placing them on a finishing ration that will provide nutrients for the maximum rate of gain that the genetic make up of the animal will allow. High grain corn silage (35% to 50% grain) plus the required amount of protein supplement will provide a daily net energy intake that will allow a gain of about 1.8 lb. per day. A mixture that is approximately 40% shelled corn, barley or wheat and 60% hay will also provide a net energy intake that will result in a 1.8 to 2.0 lb. per day gain. The growing ration can then be fed by feeding the pounds of grain and supplement required daily plus all of the roughage the cattle will consume. The first ration formulated would then be designed to meet these specifications.

Formulating a finishing ration for a maximum rate of gain can then be accomplished by *feeding the minimum amount of roughage* that is needed to prevent management problems such as bloat and other digestive upsets and keeping the cattle on feed, and *then allowing the cattle to consume all of the grain they will eat plus feeding the required amount of supplemental protein, vitamins and minerals.* If feeding high moisture grain, it is usually best to feed about 15% to 20% of the ration dry matter as corn silage or about 10% to 15% as hay to keep the ration in a desirable physical condition. When using dry grain, the roughage can be limited to 5% to 15% of the ration dry matter.

Mixtures of the growing and finishing rations can be used to get the cattle slowly changed to the finishing ration in a stepwise manner, taking two to three weeks for the ration change.

Method of Formulating Rations

Step 1. *Determining the rate of gain expected from the ration.*

First determine the proportions of grain and roughage to be fed, using the guidelines previously discussed.

Enter the pounds of grain and roughage to be fed in column 1 of Table 1, using the *expected dry matter intake table* (table 2) to estimate the total dry matter intake that can be expected. Then enter the NE_m value in column 2, the NE_g value in column 4 and the total protein value in column 6 for each feedstuff. These values can be found in the feed composition tables (Bull E-1624). Enter the Mcal of net energy required daily for maintenance for the weight of the cattle in the blank provided in part 2A of the worksheet. This energy value can be found in the *energy requirement tables* under the weight of the cattle for which the ration is being formulated (Bull E-1653). Then perform the following steps, as outlined at the bottom of table 1:

A. Multiply each feed times its NE_m value per pound in column 2 and enter the results in column 3. Then add up column 3 and divide this total by the total estimated dry matter intake (sum of column 1). This gives the *net*

energy value of this combination of feedstuffs per lb. for maintenance.

B. Divide the total Mcal required for maintenance (as found in E-1653 for the weight of cattle) by the NE_m per pound value of the ration, as determined in part A above. *This gives the pounds of ration required daily for maintenance.*

C. Then subtract the pounds required for maintenance from the total expected dry matter intake (sum of column 1) to get the *pounds left for gain.*

D. Multiply each feed times its NE_g value per pound in column 4 and enter the result in column 5. Then add up column 5 and divide this total by the total estimated dry matter intake (sum of column 1). This gives the *net energy value of this combination of feedstuffs for gain.*

E. Multiply the pounds of feed left for gain as determined in part C above times the net energy for gain value of the ration per pound as determined in part D above. *This gives the MCal of net energy available for gain per day.*

F. Find the *expected rate of gain* for these cattle in the energy requirement tables (E-1653) *under the weight and sex of the cattle and across from the value that corresponds to the MCal net energy available for gain* as determined in part E.

If this rate of gain is not satisfactory, then the combinations of feedstuffs should be adjusted and a new expected rate of gain calculated.

Step 2. *Determining the amount of protein supplement needed.*

A. Multiply the pounds of each feedstuff in column 1 times its percent total protein in column 5 and enter the result in column 7.

B. Add up column 7 to get the pounds of total protein furnished by this combination of feedstuffs.

C. *Find the total pounds of total protein required daily* in Bull. E-1628 for the weight of cattle and rate of gain that was calculated in part F.

D. Subtract the pounds of total protein already in the ration (sum of column 7) from the total pounds of total protein required to get the pounds *total protein needed from a protein supplement.*

E. Divide the pounds of total protein needed from a protein supplement by the per cent total protein in the supplement, then multiply the result by 100. *This gives the pounds of protein supplement needed per head daily.*

Step 3. Find the correct moisture multiplier in Bull. E-1654 across from the per cent moisture of each feed and enter these in column 9. Then multiply this value times the pounds of dry matter of the feedstuff in column 1 and enter this result in column 10. *This will give the pounds of each feed to be fed per head daily on an as fed basis.*

The ration is now balanced for energy and protein. If cattle consume the protein supplement in addition to the previously estimated total dry matter intake, then the actual gains will be higher than those predicted because of the additional energy obtained from the supplement. If the supplement replaces part of the grain, however, the actual gains may be somewhat less than predicted. The precise expected rate of gain can be calculated after the ration has been completely formulated. In feeding a growing ration, *the pounds of grain and protein supplement intake should be fed as calculated and the hay or corn silage fed free choice.* In finishing rations the *pounds of hay or silage and protein supplement should be fed as calculated and the grain fed free choice.*

Step 4. *Calculating the estimated cost of gain on this ration*

Multiply the pounds of each feed to be fed times its cost per pound. Then add these and divide by the expected rate of gain, as determined in part 1.

Step 5. *Meeting mineral requirements*

Whether or not supplemental calcium or phosphorus are needed can be determined by multiplying the pounds of each feed (column 1) times its per cent calcium or phosphorus (E-1624), then adding up the total furnished by each of the ration ingredients. Subtract from the total required (found in the mineral requirement table, Bull. E-1627) to get the amount still needed. Then divide this deficiency by the per cent of calcium or phosphorus in the mineral supplement (E-1624) and multiply the result by 100 to determine the pounds of the mineral supplement needed. (These steps are the same as those described in determining the pounds of protein supplement needed.) A good free choice mineral mixture for growing-finishing rations is a mixture of one part dicalcium phosphate, one part ground limestone and one part of trace mineralized salt. Trace mineralized salt will normally be sufficient to provide adequate trace minerals in the ration. Only one supplemental source of trace minerals should be used in the ration, and if the protein supplement contains trace minerals plain white salt should be used in the mineral mixture. A more complete discussion of meeting mineral requirements is given in Bull. E-1627.

Step 6. *Vitamins and additives*

A source of supplemental *vitamin A* should be used to provide *20,000 international units per head daily.* One of the growth stimulating compounds such as *Compudose, Ralgro, Synovex S or H, or MGA* should be used at the recommended levels for maximum rate of gain and feed efficiency. High levels of antibiotics fed for the first 30 days and then a continuous low level of antibiotics throughout the feeding period has been shown to be beneficial in increasing gains and feed eefficiency and preventing liver abscesses.

TABLE 1. RATION FORMULATION WORKSHEET

Ration for: Sex Steers Weight 500 lb. Ration type grower - finisher
Ration specifications: Daily expected 100% dry matter consumption 12.5 lb.

FEEDSTUFFS	Col. 1 Dly. lb. 100% DM	Col. 2 NE_m per lb. (Find in File 1102)	Col. 3 Total Mcal NE_m (Multiply Col. 1 x Col. 2)	Col. 4 NE_g per lb. (Find in File 1102)	Col. 5 Total Mcal NE_g (Multiply Col. 1 x Col. 4)	Col. 6 percent protein (Find in File 1102)	Col. 7 lb. protein (Multiply Col. 1 x Col. 6)	Col. 8 percent moisture (From feed analysis)	Col. 9 moisture multiplier (Find in File 1103)	Col. 10 lb. as fed (Multiply Col. 1 x Col. 9)
shelled corn	3	1.02	3.06	.67	2.01	10.0%	.30	30	1.43	4.3
alfalfa hay	2	.57	1.14	.27	.54	20.6%	.41	12	1.12	2.3
corn silage	7.5	.70	5.25	.46	3.45	8.4%	.63	65	2.86	21.4
Totals of Colums	12.5		9.45		6.00		1.34			

TABLE 2. EXPECTED DAILY 100% DRY MATTER INTAKE OF BEEF CATTLE

Body weight, lb.	300	400	500	600	700	800	900	1000	1100	1200
Expected daily feed intake, 100% Dry Matter Basis	9.0	11.0	12.5	14.5	16.5	18.5	20	21.5	23	24

METHODS

A – Predicting rate of gain

A1. NE_m per lb. of ration = $\frac{9.45}{12.5} = .76$ (Col. 3 total) / (Col. 1 total)

A2. Daily NE_m required = 4.55 megcal (from E-1653)

A3. Lb. needed for maintenance = $4.55/.76 = 6$ (Daily NE_m required) / (Ration NE_m per lb.) (from A1 and A2)

A4. Lb. left for gain = $12.5 - 6 = 6.5$ (Col. 1 total - lb. needed for NE_m) (from A3)

A5. NE_g per lb. of ration = $\frac{6.0}{12.5} = .48$ (Col. 5 total) / (Col. 1 total)

A6. Mcal NE left for gain = $6.5 \times .48 = 3.12$ (lb. left for gain from A4 x NE_g per lb. of ration from A5)

A7. Expected rate of gain = 2.0 (This is found in E-1653 for the weight and sex of the cattle and across from the value that corresponds to the Mcal NE left for gain as calculated above).

B – Meeting the protein requirements

B1. Lb. protein furnished by ration = 1.34 (Sum of Col. 7)

B2. Lb. protein required daily = 1.64 (from E-1628)

B3. Lb. protein still needed = $1.64 - 1.34 = .30$ (Lb. required - sum of Col. 7)

B4. Lb. protein supplement needed = $\frac{.30}{40} \times 100 = \frac{3}{4}$ (Lb. protein still needed) / (percent protein of supplement) x 100

C – Minerals: (calculate in the same way the protein needs were calculated)

D – Cost of ration

D1. Total cost of ration = 80¢ (Lb. of each ingredient to be fed x per lb. cost of ingredient, then total up cost of all ingredients).

D2. Feed cost per lb. of gain = $\frac{80¢}{2} = 40¢$ (total cost of ration) / (expected gain, from A7)

D3. Total cost per lb. of gain = $\frac{80¢ + 50¢}{2} = 65¢$ (total cost of ration + 50 cents), or D1 + 50 cents / (expected gain) from (A7)

TABLE 1. RATION FORMULATION WORKSHEET

Ration for: Sex_____ Weight_____ lb. Ration type_____
Ration specifications: Daily expected 100% dry matter consumption _____ lb.

FEEDSTUFFS	Col. 1 Dly. lb. 100% DM	Col. 2 NE_m per lb. (Find in File 1102)	Col. 3 Total Mcal NE_m (Multiply Col. 1 x Col. 2)	Col. 4 NE_g per lb. (Find in File 1102)	Col. 5 Total Mcal NE_g (Multiply Col. 1 x Col. 4)	Col. 6 percent protein (Find in File 1102)	Col. 7 lb. protein (Multiply Col. 1 x Col. 6)	Col. 8 percent moisture (From feed analysis)	Col. 9 moisture multiplier (Find in File 1103)	Col. 10 lb. as fed (Multiply Col. 1 x Col. 9)
Totals of Colums										

TABLE 2. EXPECTED DAILY 100% DRY MATTER INTAKE OF BEEF CATTLE

Body weight, lb.	300	400	500	600	700	800	900	1000	1100	1200
Expected daily feed intake, 100% Dry Matter Basis	9.0	11.0	12.5	14.5	16.5	18.5	20	21.5	23	24

METHODS

A – Predicting rate of gain

A1. NE_m per lb. of ration = _____ (Col. 3 total) / (Col. 1 total)

A2. Daily NE_m required = _____ megcal (from E-1653)

A3. Lb. needed for maintenance = _____ (Daily NE_m required) / (Ration NE_m per lb.) (from A1 and A2)

A4. Lb. left for gain = _____ (Col. 1 total - lb. needed for NE_m) (from A3)

A5. NE_g per lb. of ration = _____ (Col. 5 total) / (Col. 1 total)

A6. Mcal NE left for gain = _____ (lb. left for gain from A4 x NE_g per lb. of ration from A5)

A7. Expected rate of gain = _____ (This is found in E-1653 for the weight and sex of the cattle and across from the value that corresponds to the Mcal NE left for gain as calculated above).

B – Meeting the protein requirements

B1. Lb. protein furnished by ration = _____ (Sum of Col. 7)

B2. Lb. protein required daily = _____ (from E-1628)

B3. Lb. protein still needed = _____ (Lb. required - sum of Col. 7)

B4. Lb. protein supplement needed = _____ (Lb. protein still needed) / (percent protein of supplement) x 100

C – Minerals: (calculate in the same way the protein needs were calculated)

D – Cost of ration

D1. Total cost of ration = _____ (Lb. of each ingredient to be fed x per lb. cost of ingredient, then total up cost of all ingredients).

D2. Feed cost per lb. of gain = _____ (total cost of ration) / (expected gain, from A7)

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COOPERATIVE EXTENSION SERVICE

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