Beef Cattle Feeding Suggestions

- **Nutrient requirements**
- **Balancing rations**
- **Protein supplements**
- **Suggested rations**

COOPERATIVE EXTENSION SERVICE COLLEGE OF AGRICULTURE
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CONTENTS

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This publication provides feeding recommendations and suggested rations for beef cattle based on recent research at several agricultural experiment stations. These suggestions are only guidelines, because variation in animal response can result from differences in breed, age, health, and condition of animals or from differences in climate, feed quality, or method of feeding.

NUTRIENTS REQUIRED BY BEEF CATTLE

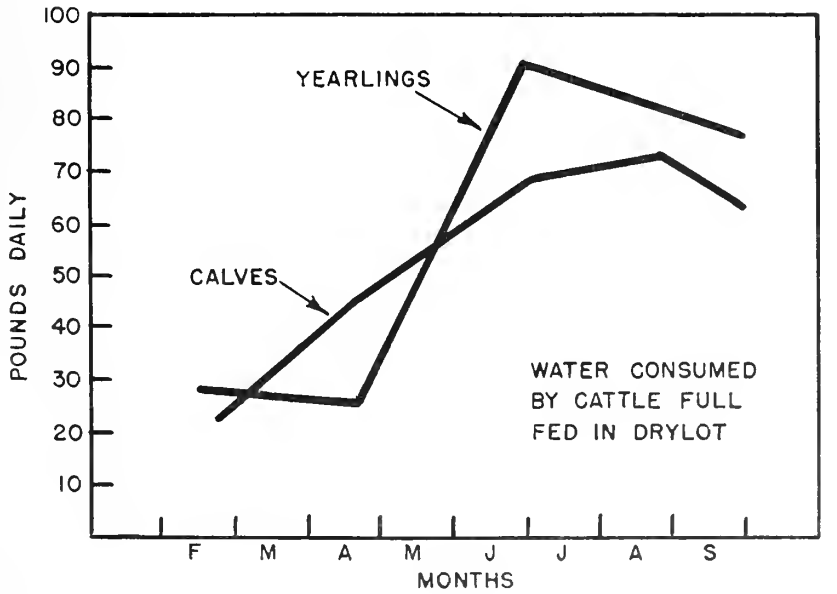
Beef cattle require water, energy, protein, minerals. and vitamins. Rations should be balanced for a particular purpose, so that no one nutrient becomes a limiting factor in the animal's production or growth.

Water

The amount of water cattle require depends on the kind of feed they receive, the amount of water in the feed, and the climate.

Water makes up more than 60 percent of the body composition of a 700-pound steer and more than 50 percent of a 1,000-pound steer. The functions of water are: (1) to dissolve nutrients and to move them in the blood stream; (2) to aid in removing body wastes; and (3) to control body temperature through evaporation at the skin surface as well as through the lungs. Animals can get along without food longer than they can without water. A limited water intake can reduce appetite and feedlot performance.

The amount of water consumed increases rapidly as the air temperature increases, as shown by the chart below.



Energy and Feed Consumption

The chief source of energy in animal feeds is carbohydrates. They form about 75 percent of all the dry matter in plants. In the usual chemical analysis of feeds, carbohydrates are divided into nitrogen-free extract (NFE) and fiber. NFE, the more soluble part, includes sugars, starches, organic acids (like lactic and acetic acid, present in silage), and the most soluble portions of other more complex carbohydrates. Fiber includes the less soluble carbohydrates, such as cellulose and lignin. Fats furnish 2.25 times as much energy as do carbohydrates. Natural plant protein sources, besides furnishing nitrogenous compounds, also supply energy.

The approximate energy value of a feed is described as total digestible nutrients (TDN); the energy requirements of beef cattle are generally expressed as TDN. The TDN of a feed is the sum of all of the digestible organic nutrients — including NFE, fiber, protein, and fat ($\times$ 2.25).

While the TDN system has been used for many years, it has been criticized because it does not distinguish between energy needs for maintenance and for production, and because TDN from roughage does not have the same energy value as TDN from grain.

Attempts have been made to develop a more precise system of evaluating feedstuffs for energy. In recent years the "California" net energy system has been used in some of the larger feedlots. The net energy system is more sensitive to factors such as differences in cattle, climate, and feed quality. It involves a prediction of rate of gain from the types and quantities of feeds fed or conversely the amounts of feed or ration needed to produce a certain rate of gain. Feeds are evaluated separately on their value for maintenance and for production.

The TDN system is accurate enough to be used as a guide for practical feeding programs. The TDN level of a maintenance ration or of a growing ration should be adjusted according to the condition of the animals. The TDN level of a finishing ration is dependent upon the concentrate-to-roughage ratio chosen by the feeder.

Proper energy levels and energy utilization are important to the success of the cattle feeder, for energy represents 85 to 90 percent of the nutrients needed by beef cattle.

Both condition (degree of finish) and age affect the feed capacity of cattle. There also seems to be a considerable variation between cattle of the same condition and age. However, cattle on finishing rations will consume approximately 2.5 to 3 percent of their liveweight in air-dry feed daily — including grain, protein supplement, and roughage.

A minimum full feed of grain is considered to be more than 1.5 pounds daily per 100 pounds of liveweight, including the grain in corn silage. If roughage is available, maximum gain should be obtained with not more than about 2 pounds of grain daily per hundredweight.

Protein

Protein is a primary component of animal bodies, making up a large part of the muscles, internal organs, cartilage, connective tissue, skin, and hair. All natural feedstuffs contain some protein because protein is a constituent of cell walls and components in plants just as it is in animals. Proteins are made up of nitrogenous compounds called amino acids, and ruminant animals have a unique way of converting plant protein or nonprotein nitrogen plus energy into animal protein. Microbes in the rumen attack plant protein and break most of it down into simple compounds before this material is incorporated into their own bacterial bodies. Similarly, the bacteria can use simple compounds like urea to build protein as long as a source of energy is available.

Protein quality (balance of amino acids) is therefore not as important for ruminants as it is for simple-stomached animals. However, recent research at the University of Illinois indicates that the balance of amino acids actually absorbed by ruminants can be improved if rumen microbial activity on protein is bypassed. Early work with specially treated soybean meal showed increased rate of gain in cattle and lambs. The purpose was to prevent the "bugs" from breaking down the soybean protein in the rumen, allowing protein digestion in the abomasum (true stomach) to occur in a manner similar to that in simple-stomached animals. More research will be needed before this discovery can be applied, but this does represent a potential increase in efficiency.

Natural feedstuffs like grains, pasture forage, silages, and cured roughages as well as many byproducts such as soybean meal supply protein. The digestibility of protein is quite low in poor-quality roughages such as cobs, straw, corn stover, or cottonseed hulls. The differences in protein digestibility in some common feeds are shown below:

Corn	77%	Soybean meal	92%	Alfalfa hay	71%
Oats	78%	Cottonseed meal	80%	Red clover hay	60%
Wheat	84%	Linseed meal	84%	Corn silage	55%
Barley	79%	Ground cobs	0%	Alfalfa silage	65%
Milo	78%	Cottonseed hulls	0%	Legume pasture	70%

The requirement for crude protein ranges from 10 percent of the air-dry ration for finishing yearling and 2-year-old cattle to 11 percent

crude protein for calves. However, recent research at the University of Illinois suggests that fast-growing calves may need 13 percent or more crude protein if they are fed a high-energy ration. A general practice has been to provide at least 11 percent crude protein in growing rations for calves or finishing rations for yearlings. The crude protein requirement can also be expressed as pounds needed per head per day.

You will need to make some conversions for silage and haylage in estimating the pounds of air-dry feed eaten daily. A fairly accurate estimate is to assume that it takes 1.5 pounds of 40-percent moisture haylage or 3 pounds of 70-percent moisture silage to equal the dry matter in 1 pound of hay.

In cases of extreme variations in moisture content, calculate the actual amount of dry matter and divide by 0.90 to convert to a 90-percent dry matter basis.

Example: Convert 18 pounds of 55-percent moisture corn silage to pounds of 90-percent dry matter feed. Dry matter is 100 — 55 or 45 percent. Multiplying 0.45 by 18 = 8.1; dividing 8.1 by 0.90 = 9 pounds of 90-percent dry matter feed.

Urea. Urea is a nitrogen-rich synthetic compound manufactured by using nitrogen from the air. It contains 45 percent nitrogen, while natural protein has 16 percent nitrogen. Since the ratio of nitrogen to total crude protein is 1 to 6.25, we can multiply the nitrogen in urea by 6.25 to get a protein equivalent value for urea of 281 percent. To calculate the protein equivalent furnished by urea (45 percent nitrogen) in a supplement, multiply the percent of urea by 2.81. To determine the amount of urea in 100 pounds of supplement, divide the percent of crude protein equivalent furnished by the urea by 2.81.

Urea does not furnish energy as do the natural proteins such as soybean meal. Approximately 1 pound of urea and 6 pounds of corn will replace the protein and energy supplied by 7 pounds of soybean meal.

When cattle are given urea for the first time, an adjustment period of about two weeks is required before the rumen microbial population can make the most effective use of the urea. Calves may need a longer adjustment period than yearlings, and experiments with calves have often shown slightly lower weight gains when all-urea supplements were used rather than those containing some plant protein.

The low cost of nitrogen in urea has encouraged its use in finishing rations. Urea is most effectively used when fed with a readily available source of energy such as grain or molasses. For cattle fed high-grain

finishing rations, the supplemental protein needed usually represents less than a third of the total crude protein in the ration, and a general rule has been that urea could supply up to a third of the total crude protein in the ration. The following facts are important to remember when urea is used:

- Urea hydrolizes quickly, releasing ammonia which could flood the system if urea is fed in large quantities. Ammonia released rapidly in large quantities in the rumen is toxic to the animal.
- Thorough blending or mixing of the urea supplement in the grain mixture or (preferably) in the complete diet is vital in controlling the amount available to one animal. If this is done, there is no danger of ammonia toxicity even if feed intake is relatively high.
- Cattle on a full feed, either on a self-feeder or with grain before them almost continuously in the bunk, should make the most efficient use of urea. This permits more frequent intake and tends to supply a more constant amount of ammonia in the rumen.
- Since urea furnishes nitrogen only, rations need to be accurately formulated. There may be need for additional mineral and vitamin supplementation.

Various high-urea supplements have been formulated, but in recent Illinois tests simple supplementation programs involving urea, trace-mineralized salt, and calcium-phosphorus sources have been adequate for finishing yearling cattle. Feedlot performance was not improved when urea-containing rations were supplemented with dehydrated alfalfa meal, sulfur, or vitamin E. However, the sulfur level in some rations may be borderline or deficient for effective urea utilization, and the ratio of nitrogen to sulfur in the ration should be between 12:1 and 15:1.

Minerals

Calcium, phosphorus, and salt are the minerals normally added to beef cattle rations or offered free choice.

A calcium deficiency is most likely to occur in cattle on a high-concentrate ration, a phosphorous deficiency on a high-roughage ration. As a rule of thumb, the total ration, on an air-dry basis, should contain about 0.5 percent salt and 0.3 percent each of calcium and of phosphorus. Trace-minerals are not usually deficient in Illinois beef rations, but be alert for situations or areas where deficiencies have occurred. Use trace-mineralized (TM) salt to support adequate trace-mineral intake.

Equal parts, by weight, of dicalcium phosphate and trace-mineralized salt make a good home-mixed mineral mixture containing approximately 12 percent calcium, 9 percent phosphorus, and 50 percent trace-mineralized salt. The high phosphorus content makes the mixture especially suitable for high-roughage rations.

Equal parts, by weight, of dicalcium phosphate, finely ground limestone, and trace-mineralized salt will make a general-purpose simple mineral mixture containing approximately 20 percent calcium, 6 percent phosphorus, and 33 percent salt. The higher calcium content makes it more suitable for use with high-concentrate rations.

Minerals may be fed free-choice or mixed into a complete ration. Feed trace-mineralized salt and a simple mineral mixture, each free-choice, regardless of ration composition. Cattle will eat little of a simple mineral mixture if the ration mineral fortification is adequate.

Vitamins

Vitamins are broadly classified into two groups, the fat-soluble (A, D, E, and K) and the water-soluble, or B-complex vitamins.

Vitamin D is synthesized in the skin of animals in direct sunlight and is available in sun-cured hay. Cattle in confinement may need additional vitamin D.

The rumen organisms can synthesize vitamin K.

At present, no consistent benefit has been reported from supplemental vitamin E.

Vitamin A is of major, practical significance in beef cattle feeding. Vitamin A deficiencies appear in feedlot cattle receiving rations that we formerly thought contained adequate amounts of carotene. Carotene is the precursor of vitamin A, converted into A in the paunch. Carotene is found in abundance in pasture and green roughages, as well as in yellow corn.

We recommend adding the following minimum amounts (International Units) of *true vitamin A* per head daily to the rations of feeder cattle:

Cattle wintered on corn silage	10,000 I.U.
Cattle full-fed during the winter	20,000 I.U.
Cattle full-fed grain on pasture	20,000 I.U.
Cattle fed in drylot in the summer	30,000 I.U.
Cattle being pastured with no grain, or wintered on rations that are mostly hay or legume silage	No extra vitamin A

Recommended amounts to add to a ton of supplement are given in Table 1.

Table 1. — Recommended Amounts of True Vitamin A To Be Added per Ton of Supplement

	Addition per ton when supplement is fed at the rate of 1 pound per head per day	Addition per ton when supplement is fed at the rate of 2 pounds per head per day
	(International Units)	
Cattle wintered on corn silage	20,000,000	10,000,000
Cattle full-fed during the winter	40,000,000	20,000,000
Cattle full-fed grain on pasture	40,000,000	20,000,000
Cattle fed in drylot in the summer	60,000,000	30,000,000

Research has indicated that the microorganisms in the paunch of mature cattle are capable of producing B-complex vitamins, generally in excess of the requirements. Materials such as yeast which are high in B-vitamins appear to be of little value in feedlot rations. B-vitamins may be needed by the very young calf before rumen fermentation is established or by starved or severely stressed cattle in which the rumen microbial activity has ceased.

RATION CONSIDERATIONS

Balancing Rations

The National Research Council publishes the nutrient requirements of beef cattle on the basis of available research data. These requirements are believed to be adequate under most conditions for normal health, growth, finishing, and reproduction. However, in practice, they are often exceeded slightly to account for variation in feed quality and individual animal needs.

The daily nutrient requirements of beef cattle can be determined from the National Research Council Tables 7 and 8 on pages 18 and 19. To illustrate the use of the tables, refer to line 8, Table 7. It gives the requirements for growing a 441-pound steer calf to gain 1.65 pounds a day. Pounds of dry matter required per animal each day are given as dry matter, *completely free of moisture.* Protein, TDN, calcium, and phosphorus requirements are given as pounds per head per day.

A normal daily ration for this calf might well be 30 pounds of corn silage, 1 pound of soybean meal, and 2 pounds of alfalfa hay. Using the feed analysis table on page 20 (lines 15, 31, and 1), calculate the total dry matter, protein, TDN, calcium, and phosphorus supplied by

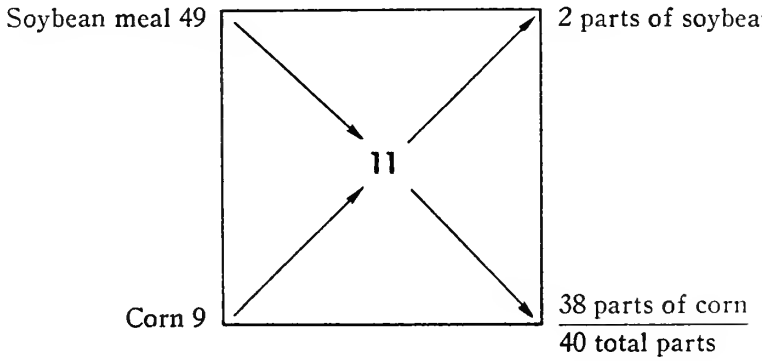
this ration. The correct figures are 11.7 pounds of total dry matter, 1.49 pounds of protein, 8.08 pounds of TDN, 0.062 pound of calcium, and 0.033 pound of phosphorus, as shown below:

	Total dry matter, lb.	*Total protein, lb.*	*TDN, lb.*	*Calcium, lb.*	*Phosphorus, lb.*
Daily requirements	11.00	1.23	7.70	.040	.031
Amount in ration					
30 lb. corn silage	9.00	.72	6.30	.030	.021
1 lb. soybean meal	.89	.46	.77	.003	.007
2 lb. alfalfa hay	1.81	.31	1.01	.029	.005
Total in feed	11.70	1.49	8.08	.062	.033

The table of requirements indicated a need for 11 pounds of total dry matter, 1.23 pounds of protein, 7.70 pounds of TDN, 0.04 pound of calcium, and 0.031 pound of phosphorus daily. Thus the ration is adequate in these nutrients and should support the rate of gain specified when these requirements are met.

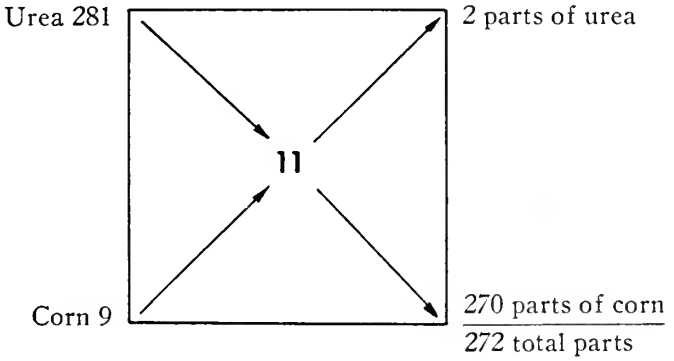
The Pierson Square can be used to determine the proportion of two feeds needed to provide a certain protein level in a mixture, as shown in these examples.

Example 1: Soybean meal at 49 percent protein and corn at 9 percent crude protein are mixed to provide an 11 percent crude protein mixture. The diagonal differences determine the parts of each feed.



2 ÷ 40 = 5 percent soybean meal
38 ÷ 40 = 95 percent corn

Example 2: Urea at 281 percent crude protein equivalent and corn at 9 percent crude protein are mixed to provide an 11 percent crude protein mixture.



2 ÷ 272 = 0.75 percent urea (15 pounds per ton of mixture)
270 ÷ 272 = 99.25 percent corn

Protein Supplements

Protein supplements may contain a variety of ingredients, especially if supplemental minerals and vitamins are to be included as well as growth stimulants. The use of additives such as hormones and antibiotics is regulated by the Food and Drug Administration, and a permit is required before such ingredients can be mixed into feeds. Levels, kinds, and combinations of hormones or antibiotics for use in finishing rations should be those recommended by the manufacturer or feed supplier and should meet any usage requirement of the Food and Drug Administration.

Simple formulas can be mixed on farms, although premixes supplying vitamins, trace minerals, and additives can be obtained in some areas. Growth-stimulating hormones can be implanted if they are not supplied in the feed.

Supplement formulas provided by various universities may vary slightly, but animal performance would probably be similar if crude protein equivalent and additives are comparable. The formulas in Tables 2 and 3 have been designed to meet the supplement needs of Illinois rations while offering simplicity and convenience for home-mixing.

High-grain finishing rations need more supplemental calcium than high-roughage growing rations. Antibiotics can be fed in high-grain rations for control of liver abscesses; use of some roughage will help

Table 2. — Supplements for High-Silage Rations

Ingredients	Percent crude protein		
	45	56[a]	68[b]
	(pounds per ton)		
Soybean meal (49% protein)	1,800	1,700	1,600
Urea (45% nitrogen)	...	100	200
Di-cal phosphate	100	100	100
Trace-mineralized salt	100	100	100
Vitamin A[c]	+	+	+

[a] About 25 percent of protein equivalent (14 out of the 56) supplied by urea.
[b] About 41 percent of protein equivalent (28 out of the 68) supplied by urea.
[c] See Table 1 for amounts of vitamin A.

Table 3. — Finishing Supplements

Ingredients	Percent crude protein				
	41[a]	54[b]	67[c]	60[d]	80
	(pounds per ton)				
Soybean meal (49% protein)	1,000	1,000	1,000	1,300	...
Urea (45% nitrogen)	100	200	300	200	550
Ground corn	600	450	...	...	695
Dried molasses	...	...	200	...	200
Ground limestone	100	150	200	200	250
Di-cal phosphate	100	100	150	150	150
Trace-mineralized salt	100	100	150	150	150
Flowers of sulfur	...	...	...	...	5
Vitamin A[e]	+	+	+	+	+

[a] About 34 percent of protein equivalent (14 out of 41) supplied by urea.
[b] About 52 percent of protein equivalent (28 out of 54) supplied by urea.
[c] About 63 percent of protein equivalent (42 out of 67) supplied by urea.
[d] About 46 percent of protein equivalent (28 out of 60) supplied by urea.
[e] See Table 1 for amounts of vitamin A.

control this problem. Higher levels of urea can be included in finishing rations. In University of Nebraska tests, good overall results were obtained from using a supplement with liberal amounts of soybean meal for the first two to three weeks, followed by a switch to a high-urea supplement. There is recent evidence in Illinois research that the addition of some plant protein is required for maximum daily gains on high-energy rations.

The formulas for finishing supplements given in Table 3 are designed for mixing into complete rations. Note that combinations of soybean meal and urea are offered as well as urea diluted with ground corn. With proper mixing facilities single ingredients in the supplements could be added to complete rations. The crude protein content of these supplements would be reduced slightly if 44 percent soybean meal is used.

Roughage Replacers

In an effort to reduce roughage handling, several attempts have been made to substitute inert materials which would stimulate the rumen to function normally.

Oyster shells have been tried but have not shown any advantage over all-concentrate rations.

Another material is a corrugated polyethylene pellet which is fed in small amounts for six days after cattle are started on an all-grain ration. The plastic supposedly remains in the rumen until slaughter and is expected to provide the physical stimulation of the rumen normally provided by roughage. Successes with the feeding of whole shelled corn suggest that roughage replacers may not be necessary. In most cases, they have not reduced the amount of grain required per unit of weight gain.

Finishing Rations

Research at the University of Illinois and at other stations indicates that cattle receiving high-energy finishing rations utilize a roughage component very poorly. In other words, the roughage replaces very little if any grain in such rations although a small amount of roughage (5 to 10 percent on an air-dry basis) will often keep the cattle healthier and support a higher rate of gain.

The digestive climate of the rumen changes when grain replaces roughage. Poor utilization of roughage in finishing rations might thus be expected. All-grain rations involving dry shelled corn or rolled high-moisture corn have been fed successfully although feedlot management must be excellent to avoid founder and severe digestive disturbances. Cattle must be comfortable and near feed and water at all times. When all the roughage is removed, the potassium level of the ration may be borderline or deficient. The requirement for potassium in all-grain rations has not been established but levels of 0.5 percent or more have been suggested. Dry corn contains about 0.3 percent potassium, and potassium as carbonate, chloride, or sulfate has been used to increase ration levels of this mineral.

Starting Cattle on Feed

If cattle have been receiving some grain before being placed in the finishing lot, their grain may be increased at the rate of 1/2 pound per day until they reach a full feed. As cattle approach full feed, watch to see that they do not overeat. Increases should be made then only if cattle clean up their feed.

If cattle are not accustomed to grain, use the following schedule:

1. First day — Feed 1 to 3 pounds of grain and 5 pounds of hay or silage equivalent. Mix grain and roughage.
2. Daily increase — Increase grain 1 pound per head daily until cattle are receiving 1 pound per hundredweight. Make sure that all cattle are eating.
3. After the daily grain allowance reaches 1 percent of the bodyweight, increase grain 1/2 pound per day for heavy feeders or 1/2 pound every other day for light feeders if the feed is cleaned up.
4. Reduce roughage allowance, but give cattle all they will eat along with the above concentrate allowances.
5. Add protein supplement as recommended in rations for various classes of cattle.
6. Cattle will be on a full feed of grain when they are eating more than 1.5 percent of their weight in grain and supplement. However, they will eat 2.0 to 2.5 percent of their weight if most of the roughage is removed.

Grain Processing

Recent tests by several universities and feed companies have shown that rolling or grinding dry shelled corn has not improved rate of gain or feed conversion for calves or yearlings. This appears to be true whether roughage is fed or not. High-moisture shelled corn (24 to 30 percent moisture), however, is utilized more efficiently when it is cracked or rolled, and some tests with heavy steers show a benefit from rolling dry corn.

Although steam flaking of corn has been shown to improve feed efficiency, the cost of the processing prohibits its use on all but high-volume operations. New methods such as dry cooking or roasting should be watched for possible benefits in smaller feedlots.

The feeding of high-moisture corn is popular in Illinois because it allows earlier harvesting of corn and results in a very palatable feed if it is handled and stored properly. In comparing high-moisture corn with dry shelled corn, some tests have shown no difference in feed efficiency while others have shown 5 to 10 percent improvement from rolled high-moisture corn (24 to 30 percent moisture). Dry-matter intake with high-moisture corn is sometimes below that obtained with dry corn, resulting in a slower rate of gain with the wet corn.

Dry corn can be reconstituted back to high-moisture grain by grinding and adding water to obtain a feed similar in feeding qualities to

natural high-moisture corn. But recent successes with the feeding of whole dry shelled corn make it questionable whether reconstitution is necessary. Actually, any differences in feed efficiency between wet and dry corn are probably outweighed by the choice of a corn harvesting and storing system which is the most practical and convenient for a given farm. High-moisture corn does not have to be stored in a gastight facility if proper care is taken to grind and seal the corn and to feed sufficient amounts to prevent surface spoilage at the opening. At many of the larger feedlots in Illinois, the operators are now storing high-moisture ground shelled corn in a trench or bunker silo with good results.

SUGGESTED RATIONS FOR FEEDER CATTLE

Rations for Growing or Wintering Steer Calves To Get Them Ready for the Finishing Lot

Ration 1. Full-feed corn silage and add enough protein supplement to bring the air-dry ration to 11 percent crude protein. For good-quality corn silage at 65 percent moisture, 2 pounds of 40 percent protein supplement per head daily would be sufficient. If 2 to 3 pounds of legume hay are fed, the supplement can be reduced to 1 pound per head per day. Expected gain, 1.5 to 1.7 pounds per head per day.

Ration 2. Full-feed alfalfa haylage and 4 pounds of corn per head daily. Expected gain, 1.5 to 1.7 pounds per head per day. If hay is used in place of haylage, the expected gain would be 1.25 to 1.5 pounds per head per day.

Ration 3. Full-feed legume-grass or oat silage, 4 pounds of corn or oats, and 2 to 3 pounds of legume hay. Add 1 pound of protein supplement per calf daily with oat silage. Expected gain, 1.5 to 1.7 pounds per head per day.

Rations for Growing or Wintering Heifer Calves To Get Them Ready for the Finishing Lot

Growing heifer calves can be fed Rations 1, 2, and 3 suggested for growing steer calves. Expected gain, 1.25 to 1.75 pounds per head per day. Since heifers tend to finish sooner than steers, they should not be fed a growing ration after they reach about 600 pounds, although this weight will vary some with the type of heifer fed. If heifers are kept on a growing ration too long, they tend to become "cowy" in appearance by the time they are finished and will be discounted in sale price when they go to market.

Finishing Rations for Various Classes of Beef Cattle

A finishing ration for any class of cattle usually contains 70 to 90 percent grain (air-dry basis). The following rations could be used for finishing calves, yearlings, and two-year-old steers as well as for lower quality cattle fed for a shorter time.

Ration 1. Full-feed dry whole shelled corn, rolled high-moisture shelled corn, or ground ear corn. The modern approach to finishing rations is to reduce roughage to 5 to 10 percent of the ration (air-dry basis). In the final ration, this would mean 5 to 10 pounds per head daily of corn silage or 1 to 2 pounds of hay. A finishing ration involving ground ear corn does not need any additional roughage. Add enough protein supplement to bring the air-dry ration to 11 percent crude protein for yearling cattle. Recent Illinois research suggests that finishing calves (500-700 pounds) may need 13 percent crude protein in the ration. Rate of gain will range from 2.5 to 3 pounds per head daily, depending on type and class as well as environmental conditions.

Ration 2. Maximize use of corn silage for finishing when the corn silage is available and cannot be used for growing other cattle. Add enough protein supplement to make an 11 percent protein ration (air-dry basis). The rate of gain will be 2.25 to 2.75 pounds per head daily, near that obtained from rations with more grain, but feed conversion will not be as good. The ratio of corn silage to grain could be handled by one of the following methods:

- Start with a full feed of corn silage and add corn at a level of 0.5 percent of bodyweight for the first 30 days. Increase the corn level by 0.5 percent of bodyweight each month until the cattle are receiving 2.5 percent of bodyweight daily. Feed corn silage to appetite as corn allowance is increased.
- Feed 20 or 25 pounds of corn silage and as much corn as the cattle will consume and still clean up the corn silage.
- Depending on the quality of the cattle and the final degree of finish desired, feed either 1 or 2 percent of bodyweight as corn and all the corn silage the cattle will clean up.

Ration 3. Maximize the use of alfalfa haylage for finishing when the haylage is available and cannot be used for growing other cattle. Starting with a full feed of haylage, provide corn at 1 percent of bodyweight daily. The corn allowance should be increased 0.5 percent each month until the cattle receive at least 2 percent of their bodyweight as grain. No protein supplement is needed unless the ration contains less

than 5 to 7 pounds of roughage on an air-dry basis. Rate of gain will be similar to that with corn silage rations, 2.25 to 2.75 pounds per day.

Ration 4. Start cattle on self-feeders containing a mixture of 50 percent ground hay and 50 percent shelled corn. The cattle should be full of hay or other feed before they are given access to the feeder and should be watched closely at first to see that they find the feed and start eating. The hay can be reduced to 10 percent of the ration in a month's time or removed completely with good management. The ration must be completely mixed. A pelleted supplement is needed with whole shelled corn. About 5 percent of a 50 percent protein supplement would balance a mixture of corn and supplement at 11 percent protein. Expected gain, 2.5 to 3.0 pounds per day.

Handling Feeder Cattle on Pasture

Thin cattle will make the best use of improved nontillable pasture if grazed without grain feeding. Maximum grass gain or pounds of beef per acre will result if grain is omitted, but heifer calves should not be grazed without grain feeding or they may be "cowy" in appearance when they are finally ready for market.

Plan 1. Pasture without grain for 60 to 100 days. Then full-feed for 4 to 5 months, preferably in drylot. Start feeding grain as soon as pasture becomes short or unpalatable as a result of hot, dry weather. In drylot use Finishing Ration 1. Expected gain, 1.25 to 1.5 pounds per head per day on pasture; 2.5 to 3.0 pounds per head per day in drylot.

Plan 2. Pasture with limited grain for 90 days; then full-feed 90 to 120 days, preferably in drylot. When on limited grain, feed about 1 pound of grain daily for every 100 pounds of liveweight. No protein supplement is needed when cattle are on limited grain and good pasture. In drylot, use Finishing Ration 1. Expected gain: 1.75 to 2 pounds per head per day on pasture; 2 to 2.5 pounds per head per day in drylot.

SUGGESTED RATIONS FOR THE BREEDING HERD

Standard Wintering Rations for Beef Cows

Ration 1. A full-feed of legume or mixed hay is a satisfactory ration for wintering the cow herd. Cows need about 20 pounds or more per head daily, depending on size and condition of the cows. A cheaper but adequate ration would be a half-feed of good legume hay and nonlegume roughages, such as straw or cornstalk pasture.

Ration 2. Full-feed legume or legume-grass silage. If it is available, cows like some dry roughage. At least 3 pounds of hay or straw per head daily will be adequate.

Ration 3. Feed a limited amount of corn silage (10 to 20 pounds) per head daily plus a half feed of legume hay.

Ration 4. Feed 10 to 20 pounds of corn silage plus 1 pound of soybean meal. Feed straw and minerals free-choice.

Ration 5. Feed 20 pounds of grass silage plus straw and minerals free-choice.

Standard Wintering Rations for Beef Bulls

Herd sires will need 5 to 6 pounds of grain daily in addition to the roughage rations listed above for cows.

Alternate Wintering Rations for Beef Cows

Ground corncobs, cornstalk pasture, bean pumice, and oat or wheat straw are examples of the low-quality roughages mentioned in the following rations. If you have such roughage, these rations will get your cattle through the winter. If the cattle are very thin, however, it may be advisable to supplement the roughage rations with some corn.

Ration 1. Feed low-quality roughage free-choice and 2 to 3 pounds of a supplement fortified with minerals and vitamin A.

Ration 2. Feed 5 pounds of good legume hay plus low-quality roughage free-choice, 1 pound of soybean meal, and minerals free-choice.

Ration 3. Feed low-quality roughage free-choice, 1 pound of alfalfa meal or pellets, 1 pound of soybean meal, and minerals free-choice.

Ration 4. Feed 10 to 15 pounds of grass silage, low-quality roughage free-choice, 1/2 pound of soybean meal, and minerals free-choice.

Ration 5. Feed fescue pasture, 1 pound of soybean meal, and minerals free-choice. If pasture has no green color, feed 1 pound of alfalfa pellets or add vitamin A to the soybean meal.

APPROXIMATE FEED REQUIREMENTS PER HEAD

Table 4. — Amounts of Feed Required per Head for Finishing Programs With Corn Silage

	Corn (bu.)	Hay (lb.)	Supplement (lb.)	Silage (tons)	Days on farm	Av. daily gain (lb.)
Steer calves (450 pounds), to gain 600 pounds	50	600	360	2.5	270	2.2
Heifer calves (400 pounds), to gain 450 pounds	40	500	300	2.0	240	1.9
Yearling steers (700 pounds), to gain 400 pounds	40	500	225	1.5	160	2.5
Yearling heifers (550 pounds), to gain 350 pounds	35	500	200	1.25	160	2.2
2-year-old steers (800 pounds), to gain 350 pounds	35	300	200	1.50	130	2.7

Table 5. — Amounts of Feed Required per Head for Finishing Programs With Alfalfa Haylage

	Corn (bu.)	55% moisture haylage (tons)	Supplement (lb.)	Days on farm	Av. daily gain (lb.)
Steer calves (450 pounds), to gain 600 pounds	65	2.25	75[a]	270	2.2
Heifer calves (400 pounds), to gain 450 pounds	50	1.75	75[a]	240	1.9
Yearling steers (700 pounds), to gain 400 pounds	50	1.25	80	160	2.5
Yearling heifers (550 pounds), to gain 350 pounds	45	1.0	80	160	2.2
2-year-old steers (800 pounds), to gain 350 pounds	45	1.25	65	130	2.7

[a] Supplement to be fed at the rate of ½ pound per day for the last 150 days on feed.

Table 6. — Amounts of Feed Required per Head for Finishing Programs With High-Concentrate Rations

	Corn (bu.)	Hay (lb.)	Supplement (lb.)	Days on farm	Av. daily gain (lb.)
Steer calves (500 pounds), to gain 500 pounds	60	600	300	200	2.5
Steer calves (600 pounds), to gain 450 pounds	55	500	270	180	2.5
Yearling steers (700 pounds), to gain 400 pounds	55	450	200	150	2.7
Yearling heifers (600 pounds), to gain 350 pounds	50	400	150	145	2.4
2-year-old steers (800 pounds), to gain 350 pounds	50	450	150	120	2.9

NUTRIENT REQUIREMENTS

Table 7. — Nutrient Requirements of Growing and Finishing Cattle (Daily Nutrients per Animal)

Line	Reference body weight (lb.)	Av. daily gain (lb.)	Daily dry matter per animal (lb.)	Total protein (lb.)	TDN (lb.)	Calcium (lb.)	Phosphorus (lb.)
Growing Steers							
1	331	0	6.0	.46	3.3	.011	.011
2	331	.55	6.8	.75	4.4	.018	.015
3	331	1.10	7.1	.86	5.1	.026	.022
4	331	1.65	7.1	.95	5.5	.037	.029
5	441	0	7.3	.57	4.2	.013	.013
6	441	.55	9.9	.99	5.7	.018	.018
7	441	1.10	10.8	1.19	6.8	.029	.022
8	441	1.65	11.0	1.23	7.7	.040	.031
9	661	0	9.9	.77	5.7	.018	.018
10	661	.55	13.4	1.19	7.7	.024	.024
11	661	1.10	17.0	1.69	9.7	.031	.031
12	661	1.65	17.6	1.96	11.0	.037	.033
13	882	0	12.3	.97	7.0	.022	.022
14	882	.55	17.0	1.41	9.7	.031	.031
15	882	1.10	21.4	1.89	12.1	.037	.037
16	882	1.65	21.8	1.94	13.9	.040	.040
Finishing Steer Calves							
17	331	2.00	7.7	.99	5.9	.046	.033
18	441	2.20	11.0	1.34	8.1	.051	.037
19	661	2.40	15.7	1.91	11.7	.057	.042
20	882	2.40	19.4	2.16	14.3	.055	.044
21	992	2.30	20.7	2.29	15.2	.046	.046
Finishing Yearling Steers							
22	551	2.90	15.9	1.76	11.4	.064	.044
23	661	2.90	18.3	2.02	13.2	.064	.046
24	882	2.90	22.7	2.51	16.3	.062	.051
25	1102	2.65	25.4	2.82	18.3	.057	.057
Finishing Two-Year-Old Steers							
26	772	3.10	22.7	2.51	16.1	.066	.053
27	882	3.10	24.9	2.75	17.6	.066	.055
28	1102	3.10	29.5	3.28	20.9	.066	.066
29	1213	2.90	30.2	3.34	21.3	.066	.066
Finishing Heifer Calves							
30	331	1.80	7.7	.99	5.9	.040	.029
31	441	2.00	11.0	1.34	8.1	.046	.033
32	661	2.20	16.1	1.96	11.9	.051	.040
33	882	2.10	19.2	2.13	14.1	.051	.042
Finishing Yearling Heifers							
34	551	2.65	16.8	1.85	12.1	.059	.044
35	661	2.65	19.0	2.09	13.6	.059	.044
36	882	2.65	23.6	2.62	16.9	.066	.053
37	992	2.40	24.3	2.68	17.4	.053	.053

Source: Nutrient Requirements of Beef Cattle, Fourth Revised Edition, 1970. National Research Council, National Academy of Sciences, Washington, D.C.

Table 8. — Nutrient Requirements of the Breeding Herd
(Daily Nutrients per Animal)

Line	Reference body weight (lb.)	Av. daily gain (lb.)	Daily dry matter per animal (lb.)	Total protein (lb.)	TDN (lb.)	Calcium (lb.)	Phosphorus (lb.)
Growing Heifers							
1	331	0	6.0	.46	3.3	.011	.011
2	331	.55	7.1	.79	4.4	.018	.015
3	331	1.1	7.1	.86	5.1	.026	.022
4	331	1.65	7.3	.97	5.7	.037	.029
5	441	0	7.3	.57	4.2	.013	.013
6	441	.55	10.1	1.01	5.7	.018	.018
7	441	1.1	11.0	1.23	7.0	.029	.022
8	441	1.65	11.9	1.32	8.1	.040	.031
9	661	0	9.9	.77	5.7	.018	.018
10	661	.55	13.7	1.21	7.7	.024	.024
11	661	1.1	18.1	1.80	10.3	.033	.033
12	661	1.65	19.0	2.09	11.9	.037	.033
13	882	0	12.3	.97	7.0	.022	.022
14	882	.55	17.0	1.41	9.7	.031	.031
15	882	1.1	22.5	2.00	12.8	.040	.040
16	882	1.65	23.4	2.07	14.7	.042	.042
Dry Pregnant Mature Cows							
17	772	...	12.8	.75	6.2	.020	.020
18	882	...	14.1	.84	7.0	.022	.022
19	992	...	15.0	.88	7.5	.026	.026
20	1102	...	16.8	.97	8.4	.026	.026
21	1213	...	17.6	1.03	8.8	.026	.026
22	1323	...	19.0	1.10	9.5	.029	.029
Cows Nursing Calves, First 3-4 Months After Calving							
23	772	...	19.0	1.74	10.8	.055	.044
24	882	...	20.5	1.89	11.7	.057	.046
25	992	...	21.8	2.00	12.3	.062	.048
26	1102	...	23.1	2.13	13.2	.062	.051
Bulls, Growth and Maintenance (Moderate Activity)							
27	661	2.2	19.2	2.66	12.3	.051	.040
28	882	2.0	22.0	2.93	14.3	.042	.040
29	1102	1.5	26.5	3.52	15.6	.046	.046
30	1323	1.1	25.6	3.12	15.2	.046	.046
31	1543	.66	28.0	3.10	15.8	.051	.051
32	1764	0	21.8	2.18	12.3	.040	.040
33	1984	0	23.6	2.35	13.4	.042	.042

Source: Nutrient Requirements of Beef Cattle, Fourth Revised Edition, 1970. National Research Council, National Academy of Sciences, Washington, D.C.

Table 9. — Nutrient Content of Commonly Used Feedstuffs

Line	Feed	Total dry matter	Total protein	TDN	Cal-cium	Phos-phorus
				(percent)		
1	Alfalfa, hay, all analyses	90.5	15.3	50.7	1.47	.24
2	Alfalfa meal, dehydrated	92.7	17.7	54.4	1.6	.26
3	Bromegrass hay	88.8	10.4	49.3	.42	.19
4	Red clover hay, all analyses	88.3	12	51.8	1.28	.2
5	Clover-timothy hay (30-50% clover)	88.1	8.6	51	.69	.16
6	Ladino clover hay	89.5	18.5	59.5	1.53	.29
7	Corncobs	90.4	2.3	45.7	.11	.04
8	Lespedeza hay, in bloom	89.1	13	46.4	1	.19
9	Mixed hay, less than 30% legumes	89.2	8.8	48.8	.9	.19
10	Oat straw	89.8	4.1	44.8	.24	.09
11	Soybean hay	88.1	14.6	48.6	1.1	.22
12	Wheat straw	92.6	3.9	40.6	.15	.07
	Silages					
13	Alfalfa, wilted	36.2	6.3	21.5	.51	.12
14	Alfalfa haylage	60	10.4	35.8	.84	.2
15	Corn, dent, well matured	30.0	2.4	21.0	.1	.07
16	Grass silage, including legumes	25.6	3.6	15.5	...	...
17	Pea vine	24.5	3.2	14	.32	.06
18	Sorghum, sweet	25.4	1.6	15.2	.08	.06
19	Sudan grass	25.7	2.2	14.4	.11	.04
20	Corn, factory waste	22.4	2	16.1	...	...
	Concentrates					
21	Barley	89.4	12.7	77.7	.06	.4
22	Corn and cob meal	86.1	7.4	73.2	.04	.22
23	Corn, No. 2	85	8.7	80.1	.02	.27
24	Cottonseed meal, solvent	91.4	41.6	66.1	.15	1.1
25	Linseed meal, expeller	90.9	35.3	76.3	.44	.89
26	Linseed meal, solvent	90.9	35.1	71	.4	.83
27	Oats	90.2	12	70.1	.09	.33
28	Rye	89.5	12.6	76.5	.1	.33
29	Sorghum, milo	89	10.9	79.4	.03	.28
30	Soybeans	90	37.9	87.6	.25	.59
31	Soybean meal, solvent	89.3	45.8	77.2	.32	.67
32	Wheat	89.4	13.5	79.6	.05	.42
33	Wheat bran	89.1	16	65.9	.14	1.17
	Minerals					
34	Steamed bone meal	95.2	12.1	...	29	13.6
35	Di-cal phosphate	...	...	...	28	18
36	Limestone	...	...	...	38	...

OTHER PUBLICATIONS ON BEEF CATTLE PRODUCTION

These are available from your county extension adviser, or you can order from Animal Science Department, 328 Mumford Hall, University of Illinois, Urbana 61801.

Beef Cattle Management Suggestions. Circular 1026.

Beef Report. This is a quarterly review of beef cattle information coming from the Departments of Animal Science, Agricultural Economics, and Agricultural Engineering. Ask your local extension adviser to place your name on his mailing list.

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