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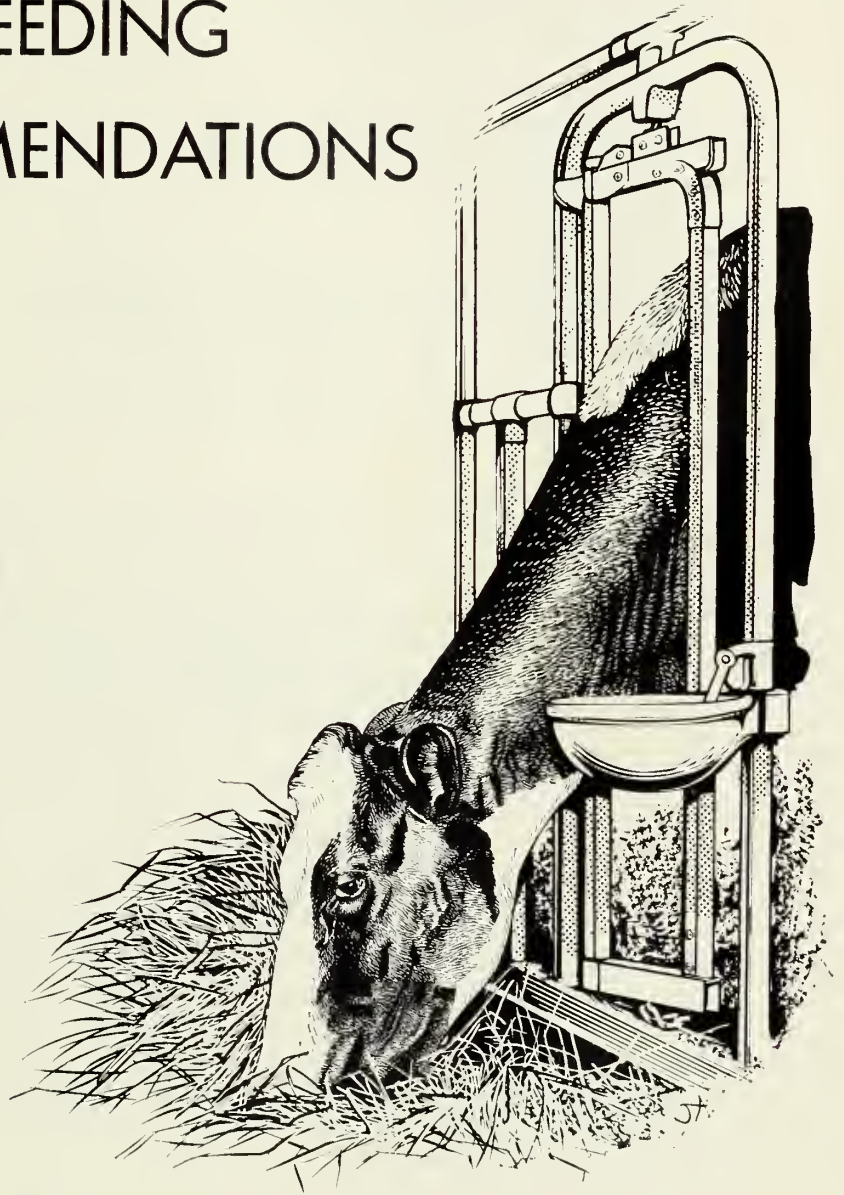
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# DAIRY FEEDING RECOMMENDATIONS

L. R. Fryman



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# DAIRY FEEDING RECOMMENDATIONS

Dairy cattle should be encouraged to eat as much high-quality roughage as possible. The main problem is that high-producing cows simply cannot obtain the necessary feed nutrients needed to sustain a heavy milk flow from roughages alone. Concentrates must be fed to the high producers to fill the gap between the nutrients required by the cow and those furnished by the roughage.

The kind and quality of roughage that is fed will dictate the type of grain mixture needed. The genetic ability of the cow to produce milk and the amount and kind of roughage that is fed will determine the amount of grain that must be fed.

Many Illinois dairy cows possess the genetic ability to produce large quantities of milk. It is up to the herdsman to use good feeding and management practices to bring out the potential of such cows. At the same time, a dairyman will want to get the highest possible net return from his dairy business. To do so, he must produce and feed high-quality roughages. They usually provide feed nutrients at a lower cost per pound than do concentrates.

## ADJUSTING GRAIN MIXTURE TO THE ROUGHAGE

Since home-grown grains usually rank next to roughages as economical sources of feed nutrients, these grains should make up the major portion of grain mixtures on most Illinois dairy farms. Mix enough high-protein supplement and minerals with crushed or medium-ground farm grains to make up for any deficiencies in the roughage. Rations with few ingredients may be just as good as those with a number of ingredients. There is no one best feed for dairy cows.

### Supplementing Stored Roughages

Most dairy herds are fed some form of stored roughage during the winter. An increasing number of dairymen feed hay or silage (or a combination of hay and silage) in drylot through the summer as well. The problems of supplementing stored roughages are about the same throughout the year.

The following grain mixtures are satisfactory when dairy cows and heifers get all the roughage they will eat. If roughage quality is lower than average, feed slightly more high-protein supplement. On the other hand, if roughage quality is excellent, feed less protein supplement than is recommended here.

**Legume hay, with or without legume-grass silage or haylage**

*(These mixtures contain about 12 percent total protein.)*

	Mixture A	Mixture B	Mixture C
	<i>(lb.)</i>	<i>(lb.)</i>	<i>(lb.)</i>
Corn .....	800	1,000	800
Oats or bran .....	...	200	500
Soybean meal, or other 44- to 50- percent protein supplement .....	100	100	100
Dicalcium phosphate, or a similar mineral supplement containing at least 15 percent phosphorus .....	10	15	18
Trace-mineralized salt .....	10	15	18

**Legume hay or haylage, with corn, sorghum, or other nonlegume silage**

*(These mixtures contain about 15 percent total protein.)*

	Mixture D	Mixture E	Mixture F
	<i>(lb.)</i>	<i>(lb.)</i>	<i>(lb.)</i>
Corn .....	900	900	600
Oats or bran .....	...	200	600
Soybean meal, or other 44- to 50- percent protein supplement .....	200	200	200
Dicalcium phosphate, or a similar mineral supplement containing at least 15 percent phosphorus .....	12	15	15
Trace-mineralized salt .....	12	15	15

**Corn or sorghum silage, alone or in combination  
with less than 6 pounds of legume hay per cow per day**

*(These mixtures contain 18 to 20 percent total protein.)*

	Mixture G	Mixture H	Mixture I
	<i>(lb.)</i>	<i>(lb.)</i>	<i>(lb.)</i>
Corn .....	800	800	600
Oats or bran .....	...	400	600
Soybean meal, or other 44- to 50- percent protein supplement .....	300	400	400
Steamed bonemeal, dicalcium phosphate, or a similar mineral supplement containing at least 15 percent phosphorus .....	14	20	20
Trace-mineralized salt .....	14	20	20



## Supplementing Pastures

Although young, rapidly growing legumes and grasses are low in dry matter, they are highly digestible. They make excellent feed for dairy animals of all ages. However, because pasture forage has a high water content, most high-producing cows cannot eat enough of it to give them the feed nutrients they need for high-level production.

Energy is the nutrient most likely to be in short supply when cows are on pasture. Therefore, high-energy grain mixtures are needed to properly supplement pastures. Mature grass pastures such as bluegrass or timothy may also be short of protein and essential minerals.

When cows are grazing on fast-growing alfalfa or legume-grass pastures, grain mixture A, B, or C (see page 4) can be used until the legumes reach the full-bloom stage. Mixtures D, E, and F or similar ones containing about 15 percent protein will be needed when mature legume-grass mixtures, bluegrass, or similar forages are grazed.

To get high-producing cows to eat enough dry matter, you may also want to feed some hay, haylage, or silage along with the pasture forage and grain.

## Supplementing Green-Chopped Forage

The problems of supplementing green-chopped forage are almost identical with those of supplementing pastures. You should consider the kind of forage and its stage of maturity when formulating grain mixtures to use with green-chopped material.

When alfalfa, alfalfa-grass, or other legume-grass mixtures are chopped before full bloom, grain mixtures A, B, and C can be used. On the other hand, mixtures containing about 15 percent crude protein (D, E, and F) are best with mature legume-grass mixtures, sudangrass, sorghum-sudan-grass hybrids, and similar forages.

## SELECTING A PROTEIN SUPPLEMENT

Since high-producing cows usually cannot obtain enough protein from farm grains and roughage to meet their needs, some other source of protein must be added to their ration. This can be obtained either from plant proteins, from nonprotein nitrogen sources, or from a combination of the two put into one supplement.

Soybean meal, linseed meal, and cottonseed meal are the most readily available plant-protein sources. Urea is the most used source of nonprotein nitrogen.

Cost and convenience are the most important considerations in selecting the best protein supplement. In general, select and buy protein supple-

ments on the basis of the cost of 1 pound of protein. Divide the percent of protein in the supplement into the cost of 100 pounds to obtain the cost per pound of protein. Also, check the list of ingredients on the feed tag of protein supplements with more than 10 percent crude fiber. Such supplements may contain screenings, hulls, or other low-value feeds.

### Soybeans as a Protein Supplement

When prices are favorable, ground soybeans, either raw or heated, can be used as a high-protein supplement.

The data in Table 1 indicate why ground soybeans can serve as a substitute for a high-protein supplement such as soybean meal. The data also show that soybean seed is only slightly higher in estimated net energy than corn or soybean meal.

A pound of soybeans usually costs considerably more than a pound of corn. Hence, from an economic point of view, you cannot afford to include more soybeans in your grain ration than are needed to bring it to the desired protein level.

If ground raw soybeans are to be included in the grain mixture, they should be ground in small amounts no more than a few days before feeding. This is because the fat in soybeans may become rancid through oxidation soon after the beans have been crushed or ground and cattle do not like to eat rancid feed.

Roasting, cooking, or otherwise heating soybeans to high temperatures will inactivate the enzyme that causes the fat in ground beans to become rancid. This reduces the need for frequent grinding of the concentrate mixtures. This is probably the main advantage of heating soybeans that are to be included in rations for dairy cattle. The economic importance of such a procedure may not be great, however, since many dairymen grind their mixtures frequently in order to have fresh, highly palatable grain for feeding.

**Table 1. — Relative Estimated Composition of Soybeans, Soybean Meal, and Shelled Corn**

	Percent crude protein	Mcal <sup>a</sup> of net energy per 100 lbs. for lactating cows
Soybeans.....	38	103
Soybean meal.....	46	84
No. 2 shelled corn.....	9	99

<sup>a</sup> Megacalories. One megacalorie equals 1,000,000 calories.

The decision to use raw or cooked soybeans in a dairy herd's grain mixture should be based on a comparison of the price of soybeans plus grinding and processing costs with the other, high-protein supplements available. For example, when the farm price per pound of soybeans is about twice that of shelled corn, a pound of ground soybeans is about equal to the value of a pound of 44-percent soybean meal in dairy grain mixtures containing a high proportion of corn. Thus, most dairymen can make the decision to use either soybean meal or soybeans simply on the basis of the price per pound for each.

## **Animal Protein**

It is not necessary to include a source of animal protein in the ration for mature dairy cows. On the other hand, when the cost of a pound of protein is less in animal-protein supplements than in plant-protein supplements, the animal-protein supplements can be mixed with farm grains to balance the ration for protein. If meat scraps or similar animal-protein supplements are used, you may have to grind the grain mixture at more frequent intervals to prevent rancidity problems.

## **Urea**

Urea can be used in place of protein supplements from plant sources when such supplements cost more than the combination of urea and farm grains needed to replace the supplement. It must be remembered, however, that urea does not supply any energy to the ration. The energy must come from the grains or roughage. The oil meals contain both protein and carbohydrates, and, therefore, furnish energy to the animal. This fact must be considered in comparing these protein supplements with urea. As a general rule, when a mixture of 6 pounds of shelled corn and 1 pound of urea costs less than 7 pounds of 44-percent soybean meal, it will pay to use urea in the dairy ration.

If you want to use urea in the grain mixture, consider the mixture on the next page for use as a protein supplement. It contains about 50 percent crude protein as well as the necessary minerals and vitamins to properly supplement a ration containing urea. Mix it with farm grains the same as you would any other 50-percent crude-protein supplement.

**Urea in corn silage.** Urea can be added to the grain mixture, or it can be put into the silage at silo-filling time. The method that will make the most efficient use of farm equipment and labor is the best one to use.

Although some of the urea put into a silo may be lost during normal fermentation, this loss should not be excessive with good management. Urea

	<i>Percent by weight</i>
Shelled corn.....	40
Alfalfa leaf meal.....	25
Dried molasses.....	10
Urea.....	15
Dicalcium phosphate.....	6
Trace-mineralized salt.....	3
Vitamin A and D supplement <sup>a</sup> .....	1

<sup>a</sup> This supplement should contain about 4.5 million International Units of vitamin A and about 567,000 International Units of vitamin D per pound.

releases ammonia, most of which is absorbed by silage acids to form organic salts. Thus, much of the urea is tied up in a form that prevents excessive losses.

Adding 10 pounds of urea to each ton of freshly chopped corn silage as it is put into the silo will increase the protein-equivalent value of the silage 30 to 40 percent and will usually not cause palatability problems if the silage contains 60 to 70 percent moisture when it is ensiled.

Ten pounds of urea per ton of silage plus only farm grains will usually not furnish enough protein for high-producing cows. Grain mixtures, such as D, E, and F on page 4, containing about 15 percent protein are satisfactory to feed with urea-treated corn silage fed as the primary source of roughage or when used in combination with legume hay.

Regardless of how urea is used in the ration, make sure it does not exceed about 1 percent of the total dry matter in the entire ration and that no more than about ½ pound of urea is included in the daily feed allowance of each animal.

Older heifers can utilize urea in their diets. But don't use urea in grain mixtures to be fed to young dairy calves. When the calves start eating as much as 1 pound of hay or hay equivalent in the form of other roughage per day per 100 pounds of body weight, grain mixtures containing no more than 3 percent urea can be fed with safety.

Urea should never be included in mixtures containing ground raw soybeans. The enzyme urease in soybeans decomposes urea, releasing an excessive amount of ammonia and making the mixture unpalatable.

### SUPPLEMENTAL MINERALS NEEDED

It is generally recognized that calcium, phosphorus, salt (sodium chloride), iodine, sulfur, magnesium, cobalt, zinc, manganese, copper, iron, potassium, selenium, and molybdenum perform essential functions in an

animal's body and thus must be present in the feed consumed. Although any of these minerals may be deficient in the feed supply, calcium, phosphorus, salt, and iodine are the most likely ones to be low in Illinois dairy feeds and are the ones that may be needed in supplemental mineral mixtures. A deficiency in any one of these four minerals may result in lowered milk production in dairy cows.

## Calcium and Phosphorus

Over 70 percent of the mineral matter of the body consists of calcium and phosphorus and these elements are very closely associated with each other in metabolism. Adequate calcium and phosphorus nutrition depends primarily upon a sufficient supply of each element, a suitable ratio between them, and an adequate amount of vitamin D. Vitamin D is obtained indirectly from exposure of the animal to sunlight, consumption of sun-cured roughage, or feeding of vitamin D supplements.

Although a desirable calcium-to-phosphorus ratio in the diet of dairy cows and heifers is about two to one, adequate nutrition can be obtained with some variation in this ratio. The optimum ratio appears to vary somewhat with the level of the elements and levels of vitamin D present in the diet. With extremely wide ratios of calcium and phosphorus, the elements may form insoluble tricalcium phosphate that cannot be used by the animal.

The amount of supplemental calcium and phosphorus needed in the ration of dairy cattle depends primarily upon the type of roughage being fed. Legume roughages are excellent sources of calcium but they are relatively low in phosphorus. Corn and sorghum silages are low in both calcium and phosphorus. Therefore, supplemental mineral mixtures to be fed with legume roughages should be low in calcium and high in phosphorus. Good mineral supplements to use with corn silage should contain both calcium and phosphorus.

Table 2 lists some of the more common sources of supplemental phosphorus and calcium used in livestock feeds, with the approximate percentages of phosphorus and calcium contained in each.

A good all-purpose mineral to use is dicalcium phosphate. Both the calcium and phosphorus contained in this mineral are readily available to the animal and the mineral can be mixed with the grain or fed on a free-choice basis in a weather-protected feeder.

A mineral containing little or no calcium such as monosodium phosphate can be substituted for dicalcium phosphate when legume roughage is the primary roughage fed. Steamed bone meal, which contains more calcium, can be used when corn silage makes up the bulk of the roughage fed. Usually it is advantageous to buy a mineral mixture that contains at

**Table 2. — Sources of Supplemental Phosphorus and Calcium**

Source	Percent of phosphorus	Percent of calcium
Dicalcium phosphate . . . . .	18-20	22-25
Steamed bonemeal . . . . .	14-15	28-30
Monosodium phosphate . . . . .	20-25	none
Sodium tripoly phosphate . . . . .	20-25	none
Disodium phosphate . . . . .	20-25	none
Limestone . . . . .	none	36-40

least 15 percent phosphorus and a ratio of calcium to phosphorus of between one to one and two to one.

A good way to supplement a dairy cow's diet with both calcium and phosphorus is to add a mineral that contains at least 15 percent readily available phosphorus and a ratio of calcium to phosphorus of no more than about two to one to the grain mixture at the rate of about 1 percent. Then give cattle free access to the mineral in a feeder designed to protect the mineral from the weather.

### Salt

Most feeds in Illinois are deficient in salt (sodium chloride). You can provide adequate amounts of these elements by adding salt to the grain mixture at the rate of about 1 percent and then giving the cows free access to loose salt. Use of trace-mineralized salt instead of plain salt provides additional mineral elements at minimal cost.

### Iodine

Parts of Illinois are located in iodine-deficient areas. Inadequate iodine intake can result in enlarged thyroid glands (goiters) in the neck of the animals and reduced milk production and growth. Fortunately, only a small amount of supplemental iodine is needed in the diet of dairy cattle. Trace-mineralized salt will provide the necessary amount of supplemental iodine required.

### Sulfur

Dairy cattle in Illinois normally obtain enough sulfur from their feed to meet their requirements. However, when urea is substituted into the diet for most of the supplemental protein from plant sources, some additional sulfur may be needed for the synthesis of the sulfur-containing amino acids. Until more precise data become available, the suggested dietary level is 0.2 percent sulfur and a nitrogen-to-sulfur ratio of ten to one in urea-

containing rations. Magnesium sulfate, sodium sulfate, and sulfur flours are frequently used as sources of sulfur.

## **Magnesium**

Cattle, primarily beef cows, receiving only legume-grass pasture forages during summer months sometimes show symptoms of magnesium deficiency when subjected to stress conditions. There is evidence to indicate that increased calcium intake and high temperatures cause an increase in the magnesium requirements of cattle. This helps to explain why the problem usually occurs while cattle are on pasture during hot weather. Furthermore, there is also evidence that grass tetany may be associated with a lack of energy in the ration and that it can be prevented by making available a good source of readily available carbohydrate in the diet. This may help to explain why milking dairy cows are less likely to have the problem than beef cows. Most Illinois dairymen feed a high-corn grain ration to provide the necessary energy for high milk-production levels the year around.

Dairy calves fed nothing but milk for extended periods of several weeks sometimes show magnesium deficiencies. Feeding hay or other roughage and a good calf starter mixture along with the milk eliminates the danger of the problem.

## **Cobalt, Zinc, Manganese, Copper, Iron, Potassium, Selenium, and Molybdenum**

These elements are usually obtained in adequate amounts from normal feeds fed to Illinois dairy cows. Trace-mineralized salt and most commercial mineral mixtures also contain sources of most or all of the elements. Insurance against possible deficiencies is usually obtained when trace-mineralized salt is fed according to recommendations.

In general, a ration that will provide adequate energy and protein to meet the requirements of the high-producing Illinois dairy cow supplemented with trace-mineralized salt and a source of readily available calcium and phosphorus will also usually furnish the necessary minerals for top milk production and rapid heifer growth.

## **VITAMINS**

Mature dairy cows need only vitamins A, D, and E in their feed. All other vitamins are produced in the rumen or tissues.

Vitamin A deficiency rarely occurs in mature dairy cattle that are being fed on pasture or on green-chopped forage. However, it may occur when poor-quality forage or roughage that has been stored for several

months is fed for prolonged periods. Cattle subsisting largely on concentrates and corn or sorghum silage with only small amounts of hay may also be susceptible to vitamin A deficiency.

If you have some doubt about the adequacy of the carotene or vitamin A intake, a supplementary source of vitamin A may be desirable. In this case, you can add a feed supplement to the grain mixture to provide about 20,000 to 30,000 International Units of vitamin A per day per cow.

Under the usual Illinois dairy-herd management conditions, an adequate amount of vitamin D is supplied by sun-cured roughage and by the action of sunlight on the animal's skin. However, there may be some question about the adequacy of the vitamin D intake for cattle that are confined most of the time and that receive only limited quantities of sun-cured hay. Fortunately, most vitamin A supplements also contain enough vitamin D to provide more than 8,000 to 10,000 International Units per cow per day when fed according to recommendations. This amount should be adequate under most conditions.

Adequate amounts of vitamin E are normally supplied by farm grains and roughages. Supplemental vitamin E is rarely needed.

## AMOUNT OF GRAIN TO FEED

At present milk-to-feed price ratios, the amount of grain fed to each cow in a herd should be determined by the cow's inherited ability to produce milk and by the kind, quality, and quantity of roughage that is fed. The stimulus to produce milk is at its peak early in the lactation. This is the time to increase grain, since it is then that a cow will respond best to a high-energy intake. You can afford to increase grain as long as the amount of money obtained from the extra milk is enough to pay for the extra grain fed.

**The challenge-feeding program.** The term "challenge feeding" has been applied to the system of feeding slightly more grain than the early lactation production seems to justify. The objective is to challenge the cow to do her best.

Give dry cows all the good-quality roughage they will eat. Let the cow's condition determine the amount of grain to be fed during the dry period. Give the average cow about  $\frac{1}{2}$  pound of grain per 100 pounds of body weight per day. A cow in good body condition will require less grain; thin cows will need more. Grain mixtures recommended for the milking herd are also satisfactory for dry cows.

Adjust the grain allowances so that during the last two weeks before calving the cow receives 1 to  $1\frac{1}{2}$  pounds of grain per 100 pounds of body



weight per day. A 1,200-pound cow should get 12 to 18 pounds of grain per day during this period.

Cows can safely take more grain at or soon after calving if they are properly conditioned to consume large quantities of grain during the late stages of the previous dry period.

**Fresh cows.** It is desirable to feed milking cows the amount of grain they will use most efficiently along with free-choice roughage. Starting about the third day after calving, give the cow all of the grain she will eat during the first four to six weeks. Be careful not to throw her "off-feed." As a guide, add about 1 pound each day to the end of the second week. Throughout the remainder of the lactation, adjust the amount of grain at weekly or monthly intervals. Table 3 gives suggested amounts of grain to feed.

**Off-feed and other disturbances.** Cows can easily be thrown off-feed or suffer digestive upsets when given large amounts of grain. Such disturbances can wipe out profits. A dairyman must know each cow's capabilities and watch her closely at all times. Any sign of refusal of the grain calls for immediate action. Most cows will take more grain if it is fed three or more times a day.

**Table 3. — Suggested Amounts of Grain to Feed to Milking Cows<sup>a</sup>**

Milk produced daily	Percent fat in milk						
	3.0	3.5	4.0	4.5	5.0	5.5	6.0
<i>lbs.</i>	<i>amount of grain to feed per day (lbs.)</i>						
10.....	1	1	2	2	3	3	4
15.....	3	3	4	4	5	6	7
20.....	4	4	5	6	7	8	9
25.....	6	6	7	8	9	11	12
30.....	7	8	9	10	11	13	14
35.....	9	10	11	12	13	14	16
40.....	11	12	13	14	15	16	17
45.....	13	14	15	16	17	18	19
50.....	15	16	17	17	18	19	20
55.....	17	18	18	19	20	21	22
60.....	19	20	21	22	22	23	24
65.....	21	22	23	24	25	26	27
70.....	24	25	26	27	28	29	30
75.....	27	28	29	30	31	32	33

<sup>a</sup> With average-quality roughage fed free-choice. Less grain will be needed if high-quality roughage is fed. More will be required with low-quality roughage.

You may wish to add 1 or 2 pounds of grain to the daily allowance of first-calf heifers for growth.

Carefully observe all cows receiving high levels of grain to immediately detect any signs of off-feed.

Cows producing 80 or more pounds of milk may be fed to appetite.

**Heavy grain feeding and mastitis.** Feeding large amounts of corn and other grains (or high-protein feeds) will not cause mastitis in dairy cattle with healthy udders. However, cows harboring the disease may be more susceptible to flareups under stress conditions. Heavy feeding accompanied by increased milk production may cause the cow to work harder, thus increasing stress. Under such conditions, good management is required to keep mastitis under control.

**Not enough time to eat grain in parlors.** High-producing cows may not have enough time to eat large amounts of grain while they are being milked in parlors. This problem is not easily solved. However, some dairymen either arrange to feed extra grain to high producers outside the parlor or group-feed a complete ration to cows according to their level of production.

Some dairymen have been successful in feeding a basic amount of grain along with the silage to all cows in the herd. High producers are given extra grain in the parlor. Adding farm grains to silage to boost energy intake has also been used on some farms.

**Low butterfat tests.** Butterfat tests may drop drastically when extremely large quantities of grain are fed and the cows eat less than 6 to 8 pounds of dry hay or its equivalent as silage per day. Increasing the amount of roughage per day to at least 1 pound per hundred pounds body weight fed as hay or its equivalent in the form of silage will usually correct the problem.

Fine grinding or pelleting of feeds may also cause low butterfat tests. Feeds of this nature may be fed with no butterfat depression by limiting the quantity used and including an adequate amount of forage.

**Feeding and udder edema.** Neither the bulkiness of the grain nor the amount of feed fed during the dry period has much effect on the amount of udder edema at calving time, nor does either one affect the length of time the swelling persists after calving. Udder edema seems to be more a matter of inheritance than of feeding practice.

**Ketosis.** Although feeding large quantities of high-energy grain before and immediately after calving probably will not prevent all cases of ketosis in dairy cows, there is evidence to suggest that a grain-feeding schedule similar to the one outlined in Table 3 may be of some benefit.

## HAND-FEEDING PROTEIN SUPPLEMENTS

A few dairymen prefer to hand-feed protein supplements instead of mixing them with farm grains. High-producing cows in these herds often

**Table 4. — To Make a Grain Ration Containing About 12 Percent Protein**

When a cow gets shelled corn (or a mixture of farm grains with 9 percent protein) <sup>a</sup>	Hand-feed one of these high-protein supplements at the rate of	
	32 percent	44 percent
(lb.)	(lb.)	(lb.)
5	.8	.5
10	1.6	1
15	2.4	1.5
20	3.2	2
25	4	2.5
30	4.8	3

<sup>a</sup> Use about 20 percent more protein supplement when ground ear corn is fed.

**Table 5. — To Make a Grain Ration Containing About 15 Percent Protein**

When a cow gets shelled corn (or a mixture of farm grains with 9 percent protein) <sup>a</sup>	Hand-feed one of these high-protein supplements at the rate of	
	32 percent	44 percent
(lb.)	(lb.)	(lb.)
5	1.8	1.1
10	3.6	2.2
15	5.4	3.3
20	7.2	4.4
25	9	5.5
30	10.8	6.6

<sup>a</sup> Use about 20 percent more protein supplement when ground ear corn is fed.

do not get enough protein supplement to satisfy their requirements. The result can be limited milk output by cows with the ability to produce at much higher levels.

Tables 4 and 5 show the amounts of two different high-protein supplements that must be added to various amounts of farm grains to make grain rations with 12 and 15 percent crude protein.

## COMPARATIVE VALUE OF FEEDS

Within certain limits, corn, oats, bran, wheat, barley, and sorghum grains can be substituted for one another in dairy grain rations. The market value as compared to their replacement value for corn and soybean meal in dairy rations is a good rule of thumb to use in evaluating

these grains for use in dairy grain mixtures. Table 6 contains factors that may be used to obtain an estimate of the feeding value of some of the more common feeds available to Illinois dairymen. To evaluate any farm grain or roughage listed in Table 6, take the following steps.

1. Multiply the factor for corn opposite the feed being evaluated by the current market price of corn.

2. Multiply the factor for soybean meal opposite the feed being evaluated by the market price of soybean meal.

3. Add the two answers. (Subtract if one of the evaluation factors has

Table 6. — Factors for Estimating Relative Values of Common Feedstuffs

	Percent dry matter	Evaluation factors	
		Corn	Soybean meal (44 percent protein)
<b>Dry roughages</b>			
Alfalfa hay, average . . . . .	90	.296	.212
Alfalfa hay, high quality . . . . .	90	.286	.259
Alfalfa hay, low quality . . . . .	90	.263	.153
Mixed hay, good, less than 30 percent legumes	90	.427	.039
Mixed hay, good, more than 30 percent legumes . . . . .	90	.371	.113
<b>Silages</b>			
Corn, dent, well-matured, well-cared . . . . .	28	.265	— .011
<b>Haylages</b>			
Mixed, good, less than 30 percent legumes . . .	50	.237	.022
Mixed, good, more than 30 percent legumes . .	50	.206	.063
<b>Concentrates</b>			
Barley . . . . .	90	.908	.093
Beet pulp, dried, not over ½ of concentrates . .	90	1.014	— .064
Brewers grain, dried . . . . .	90	.374	.464
Corn . . . . .	90	1.000	.000
Corn-and-cob meal . . . . .	90	.918	— .018
Distillers dried corn grain with solubles . . . .	90	.701	.350
Cottonseed meal, 43 percent protein, solvent process . . . . .	90	.088	.779
Linseed meal, 36 percent . . . . .	90	.201	.699
Molasses, cane, not over 10 percent of concentrates . . . . .	90	1.058	— .169
Oats, not over 25 percent of concentrates . . .	90	.924	.076
Oats, chief grain in concentrates . . . . .	90	.806	.095
Soybean meal, 44 percent protein . . . . .	90	.000	1.000
Sorghum grain, milo . . . . .	90	.916	.056
Soybeans . . . . .	90	.352	.746
Wheat . . . . .	90	.875	.125
Wheat bran . . . . .	90	.619	.218
Wheat standard middlings . . . . .	90	.743	.222

Source: F. B. Morrison. *Feeds and Feeding*. 22nd edition, 1957, p. 1073. Morrison Publ. Co., Ithaca, N.Y.

a negative value.) Use same unit weight (pounds, hundred pounds, or tons) for all feeds when making comparisons.

Example: What is average quality alfalfa hay worth when a ton of corn is worth \$50 and soybean meal is worth \$100?

$$0.296 \times \$50 = \$14.80$$

$$0.212 \times \$100 = \$21.20$$

$$\underline{\$36.00} = \text{estimated value per ton.}$$

This system considers only the digestible protein and estimated net energy contained in the feeds. It does not take into consideration the mineral and vitamin content and it has only limited use in evaluating protein supplements. In cases where there is an abundant supply of high-energy feeds, such as corn and corn silage on the farm, the objective should be to obtain protein as cheaply as possible. In this situation, the supplement that will furnish protein at the lowest cost per pound is usually the best buy.

Table 7 shows the average number of pounds of silage of various moisture levels needed to furnish the amount of dry matter found in one pound of dry hay. This is known as the "hay equivalent" value of silages.

It is evident that the percent moisture in silages greatly influences their feeding value. Silages high in moisture are usually lower in feeding value per pound than low-moisture silages. Some silages may contain so much water that milking cows cannot consume enough of them to satisfy their nutrient requirements.

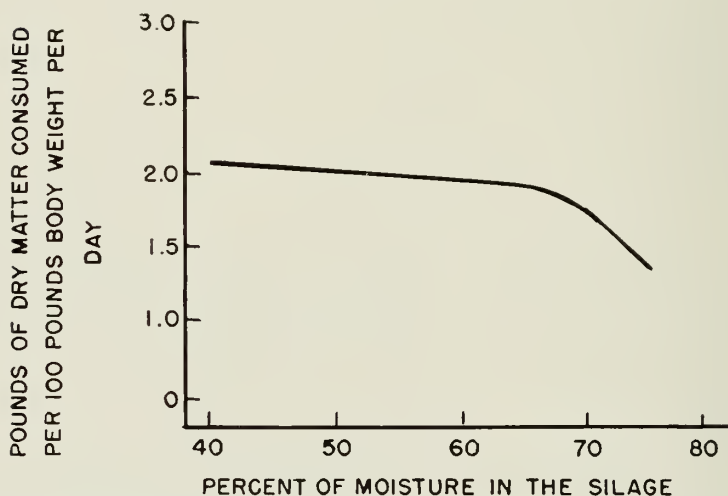
Milking cows getting grain at the rate of about 1 pound for every 3 or 4 pounds of milk produced and that have free access to either good hay or low-moisture silage will eat about 2 pounds of roughage dry matter per 100 pounds of body weight per day. If the silage contains more than 65 to 70 percent moisture, the cow's capacity may limit the amount of dry matter she can get from the silage, and dry-matter intake may drop (see Figure 1).

### Shelled Versus Ear Corn

Let convenience of handling determine whether to use shelled or ear corn in your dairy ration. Ground shelled corn is a more concentrated feed than ear corn. It contains about 10 percent more total digestible nutrients. However, there is some feed value in the cobs. When farm facilities are designed to handle ear corn, from a nutritional standpoint it will not pay to shell it before grinding for dairy cows. If low grain consumption is a problem in the milking parlor, using shelled corn in the grain mixture will help to get more energy into the cows in the limited time they are in the parlor.

Table 7. — “Hay Equivalents” of Silage With Varying Amounts of Moisture

Pct. moisture in silage	Lb. silage to equal 1 lb. hay	Pct. moisture in silage	Lb. silage to equal 1 lb. hay
90.....	9.0	60.....	2.3
85.....	6.0	55.....	2.0
80.....	4.5	50.....	1.8
75.....	3.6	45.....	1.7
70.....	3.0	40.....	1.5
65.....	2.6		



Estimated consumption of legume-grass silages (dry matter) with various moisture levels. (Fig. 1)

### High-Moisture Corn

For best results, high-moisture corn (25 to 30 percent moisture) should be ground or rolled for dairy cattle. Feeding trials indicate that the nutritive value of high-moisture corn (on a dry-matter basis) is at least equal to that of corn containing 15 percent moisture.

High-moisture ground ear corn will keep satisfactorily in a “gas-tight” silo or in a tight, conventional, upright silo equipped with a top unloader. It may be necessary to remove 2 to 4 inches per day from the top of the corn stored in a conventional silo to insure fresh corn to feed.

### Pelleted Grain

Feeding pelleted grain rations may be worthwhile when cows are milked in a parlor where their time for eating is limited. Some experiments

have shown that cows will eat pellets as much as 25 percent faster than meal. Pellets may also cut feed waste and there may be some handling advantages, but feeding entirely pelleted rations may contribute to a depression of milk fat percentage. Pelleting costs will determine the advantages, if any.

## **Bran**

Wheat bran is a good feed for dairy cows, but satisfactory grain mixtures can be formulated without it. Bran should be considered as a substitute for oats or corn in the mixture. Its price should determine its use.

## **Sprouted Grains**

For milking cows, sprouted grains do not have greater feed value than unsprouted grains. In fact, they may be somewhat less valuable, pound-for-pound. During sprouting, the grain takes up moisture and loses carbohydrates. Certain vitamins may increase in concentration as the grain sprouts, but this is of little value to the dairy cow.

## **Molasses**

Molasses is worth about three fourths as much as corn when moderate amounts are used in dairy rations. It is of less value when it makes up more than 20 percent of the ration. In addition to its nutritive value, putting about 5 percent molasses in the grain mixture may make some rations more palatable and may help to reduce dust.

## **Pelleted and Wafered Hay**

If the quality of hay put into wafers, pellets, or standard bales is the same, you can expect cows to consume about the same amount of hay in any of these forms and to produce about the same amount of milk. The butterfat test may drop when only pelleted hay is fed. Feeding some long hay or silage with the pellets usually eliminates this problem.

## **Preparing Farm Grains**

Grinding farm grains to medium fineness boosts their feeding value for mature dairy cows by 15 to 20 percent. On the other hand, grinding too fine not only costs more but may actually lower the consumption and nutritive value of certain feeds and may contribute to a depression of the milk fat test. Rolled or crushed grains are about equal in nutritive value to grains ground to a medium degree of fineness for dairy cattle.

## Grinding Hay

It does not pay to grind hay for dairy cattle. It may even lower digestibility. There is no nutritional advantage in adding ground hay to a grain mixture.

## ROUGHAGES

### Chemical Analysis of Roughages

It is extremely difficult to take accurate samples of hay and silage for chemical analysis. If you decide to have chemical tests made, get help from your extension adviser or from another reliable source. Circular 994, Getting the Most From Chemical Analyses of Roughages for Dairy Cattle, gives detailed instructions for taking feed samples. The circular is available from your extension adviser or from the Publications Office, 123 Mumford Hall, Urbana, Illinois 61801.

The figures in Table 8 that will be of greatest value to you in estimating roughage quality are the percent of crude protein, the percent of crude fiber, and the percent of moisture. Other tests can be made by a competent laboratory. However, these three (along with a close estimate of roughage consumed by the animals and information on roughage maturity when harvested) will help in evaluating the contribution of the roughage to the ration.

### Hay Conditioning

Conditioned hay will usually cure faster than hay that has not been conditioned. In one test, conditioned hay containing 75 percent moisture cut at 9 a.m. was down to 16 percent moisture by 2 p.m. the next afternoon. Hay cut at the same time and the same moisture content but not conditioned had about 30 percent moisture after drying for the same length of time. More rapid drying means the hay can be put under cover sooner with less risk of weather damage.

Table 8. — Estimated Crude Fiber and Crude Protein Percentages (Dry Matter Basis) in Roughages of Varying Quality

Roughage	Quality	Percent of crude fiber	Percent of crude protein
Legume-grass hay or silage	Excellent	25 or less	20 or more
	Good	26 to 35	19 to 14
	Fair	36 or more	13 or less
Corn and sorghum silage	Excellent	19 or less	9 or more
	Good	20 to 30	9 to 7
	Fair	31 or more	7 or less



## Effect of Browning on Haylage

If haylage heats excessively in the silo so that nonenzymatic browning occurs, its relative feeding value may be lowered. It may still test high in crude protein when subjected to a chemical test and it may have a pleasing "tobacco-like" or "caramel" odor and be consumed readily by cattle. But it can be low in digestible protein. In one trial the brown, heated haylage had only about 60 percent as much digestible protein as a similar lot of unheated haylage.

## Haylage, Hay, and Silage

If the forage is cut at the same stage of maturity, handled to retain most of the leaves, stored properly, you can expect about the same amounts of milk to be produced from the dry matter obtained from haylage, hay, and silage. This result was obtained in a test at the University of Illinois dairy farm when haylage, hay, and silage were made from three sections of the same alfalfa field. One-third was dried to about 50 percent moisture and stored in a conventional, upright silo. One third was put into a silo at 63 percent moisture. The other third was made into excellent-quality hay.

These three roughages were fed to groups of dairy cows along with grain at the rate of 1 pound of grain for every 3 pounds of 4-percent milk produced. There was no significant difference in the amount of milk produced, in pounds of FCM produced per pound of dry matter consumed, or in weight gains over the 56-day trial period.

## Corn for Silage

High-protein corn varieties have been used for making silage. When these varieties were grown on highly productive soils, the protein content of the forage was considerably higher (as much as 50 percent) than that of standard hybrid corn. When they were grown on poor, unfertilized soil, little or no difference in protein content was observed. In a study covering four seasons, the per-acre yield of forage from high-protein corn was about 18 percent below that of standard hybrid corn.

Research work with high-protein, high-oil, and high-sugar corn for silage continues. At present, the best variety of corn to use for silage for dairy cattle is the one that will yield the greatest number of bushels of grain on your farm. Wait until the kernels are well dented before you cut corn for silage.

## **Limestone-Treated Corn Silage**

In a University of Illinois trial, adding 20 pounds of feeding-grade limestone to each ton of corn silage as it was stored in a conventional upright silo did not increase its palatability or feed value for milk production. This work has been confirmed by research conducted in other states.

## **Amount of Silage to Feed**

The only limit on the amount of silage to feed a dairy cow is her capacity and willingness to accept the silage. However, when you feed cattle all the silage they will eat, you may need to adjust the grain ration. For example, when you feed large amounts of corn silage, you will need more protein in the grain ration than when you feed a considerable amount of good-quality hay. Also, if the silage has a high moisture content, you must increase the dry-matter intake. You can do this by feeding hay or by feeding more grain.

## **Dwarf Corn for Silage**

In a trial at Urbana, a good variety of hybrid corn planted in 40-inch rows yielded about 10 percent more silage per acre than dwarf corn planted in rows of the same width at about the same seeding rate. Because of its higher ear-to-stalk ratio, dwarf corn silage may be slightly higher in energy value than silage made from regular hybrids.

## **Mixture of Corn and Sorgho for Silage**

High yields of good feed can be obtained from a mixture of sorgho and corn grown for silage. One problem is to find varieties of corn and sorghums that will reach the stage of maximum yield and feed value at the same time. Harvesting can also be a problem.

## **Hybrid Sorghums**

Some of the new hybrid sorghums will produce high silage yields and are excellent as dairy feed. If you try a sorghum hybrid, be sure that it is adapted to your area and that it will produce more tonnage than corn. The feeding value of a ton of hybrid sorghum will probably not be higher than that of a ton of good corn silage. In most cases, it will be somewhat lower. Cut sorghums for silage when the seeds halfway up in the head are in the stiff dough stage.

## **Sorghum-Sudangrass Hybrids**

Sorghum-sudangrass hybrids will produce a large amount of forage during the summer and they are well suited to green chopping. On a one- or two-cutting schedule, they will probably outyield sudangrass. As a general rule, these hybrids probably will not yield as much TDN per acre as a high-yielding hybrid corn variety for silage production or alfalfa for hay production.

## **Nitrate Poisoning**

There is not much danger of nitrate poisoning from corn or sorghum silage after it has gone through the ensiling process. The big danger to the operator is from the gas that sometimes develops. Usually, this danger is over within a week or 10 days after the silo is filled.

Pasture forages, hay, and green-chopped materials may occasionally have a high enough nitrate content to cause toxicity in cattle. You can reduce the effects of feeding high-nitrate roughages by increasing concentrate feeding or by using grains or substituting forages known to be low in nitrate.

If you suspect that your roughage is high in nitrate, have a representative sample tested by a reliable analytical laboratory.

## **FEED ADDITIVES**

### **Antibiotics**

In controlled experiments, antibiotic supplementation has not significantly increased milk production. Diseases such as bacterial diarrhea and foot rot can reduce milk production. Removing such stressing agents can increase the production. In these cases, a veterinarian can best prescribe specific control measures for the disease.

### **Thyroprotein**

Feeding trials indicate that when thyroprotein is fed, cows require slightly more feed. Because individual cows vary widely in their responses to thyroprotein, returns above feed costs have varied. In general, the best response occurs for short periods in the middle of the lactation. The stimulus from thyroprotein is usually not great enough to pay for the extra cost of feeding it to the average Illinois dairy herd.

### **Yeast**

In controlled experiments, including live yeast in the grain fed to dairy cows has failed to increase either the milk production or the fat test.

## **Stilbestrol**

Various experimental results indicate that neither feeding stilbestrol nor using stilbestrol-pellet implants has any advantage in promoting more-efficient milk production in mature cows. Stilbestrol does not stimulate more rapid growth in dairy heifers and may cause reproductive problems. The use of stilbestrol is, therefore, not recommended in dairy herds, except as prescribed by a veterinarian.

## **Methionine Hydroxy Analog (MHA)**

Results of completed research on the feeding of Methionine Hydroxy Analog (MHA) to dairy cows are not consistent and a definite response has not been adequately demonstrated. Sufficient data are not yet available to establish general feeding recommendations.

## **USING FEEDING STANDARDS TO CALCULATE RATIONS**

Feeding standards were developed about 1900 from the results of feeding trials. As feeding and management practices and genetic potential of dairy cattle have changed over the years, feeding standards have been revised. The most recent revision of requirements for maintenance and milk production with instructions on how best to use them is available to you from two sources.

Leaflet D-744, *Do Allowances Equal Needs?*, revised June, 1972, is designed as a worksheet to use feeding standards to formulate dairy rations. It contains data on the requirements of dairy cattle and provides an outline for your use in determining whether your feeding program meets the requirements of your cows for total digestible nutrients (TDN) and digestible protein. You may obtain a copy from your extension adviser or from the Dairy Science Extension office, 336 Animal Sciences Laboratory, University of Illinois, Urbana, Illinois 61801.

A program using a high-speed electronic computer to calculate least-cost dairy rations is also available. It not only evaluates the energy and protein needs of dairy cattle, but also considers other nutrient requirements as well. Your extension adviser can advise you as to costs and how to make use of this program.







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