December 2013

EC627 Revised no date New Method of Feeding Milk Cows

C. W. Nibler

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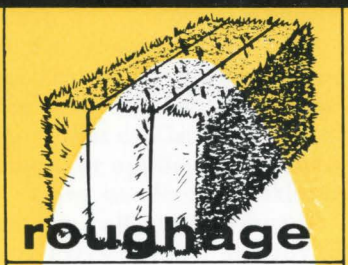

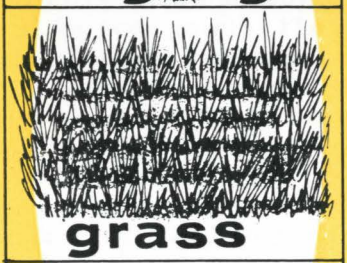

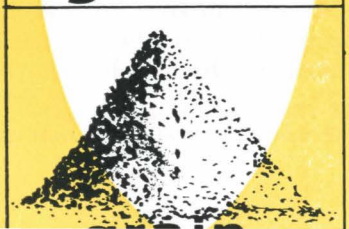

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Feeding Milk Cows

C. W. Nibler[1]

High-producing milk cows are the most efficient of the farm animals in converting roughages into edible foods for humans. In general, the dairy enterprise is a part of the farm enterprise, and nearly all the cow's feed can be produced on the farm.

The foundation of the milk cow's ration should be high-quality roughages. To supplement the roughages with additional nutrients, you should plan on feeding a balanced grain ration according to the cow's milk production. The grain ration should consist of grains plus available by-products, and then should be balanced with a high-protein concentrate.

A cow inherits from her ancestors the ability to produce milk and butterfat. It is the owner's responsibility to feed and manage her to secure profitable production year after year. It has been said that "dairymen should breed production into their cows and then feed the production out of them."

In general, profits from cows depend upon their production. Although feed costs increase with increased production, profits increase more rapidly than feed costs.

It is more profitable to feed ample and balanced rations to a few cows which have the ability to produce than to feed poorly many cows which do not have the ability to produce.

For low-producing cows, feed costs will represent more than 50 per cent of the total costs; and for high-producing cows, less than 50 per cent. Because feed costs are important in milk production, anything that can be done to decrease feed costs and maintain production should be applied to the herd.

Cows use feed to maintain their bodies, to develop the foetus or unborn calf, and to furnish energy for milk production. They convert excess feed into body fat. In addition, immature females need feed for body growth. The chart on page 4 shows why it is necessary to feed the correct amount of the proper feeds.

This diagram shows that milk cows use their feed for growth (until they are mature), body maintenance, reproduction, milk production, and body fat. In Example One, the cow receives enough feed for growth, maintenance and reproduction; but does not get enough feed for maximum milk production according to her inherited ability to produce milk. In Example Two, an excess of feed is furnished which the cow converts to body fat. During the gestation period, the cow's weight should gradually increase, but cows that become excessively fat may waste feed. In Example Three, the correct amount of feed

[1] This circular was originally written by H. P. Davis and M. N. Lawritson. It has been revised by C. W. Nibler, Extension Dairyman Specialist.

A COW USES HER FEED FOR

GROWTH	MAINTENANCE	REPRODUCTION	MILK PRODUCTION	BODY FAT
	Example. . .1			
FED TOO LITTLE——MILK PRODUCTION LOST				
	Example. . .2			
FED TOO MUCH————VALUABLE FEED WASTED				
	Example. . .3			
FED CORRECT AMOUNT——PROVES PROFITABLE				

is fed to maintain all the body functions and secure maximum milk production, and at the same time keep the cow in good condition.

When cows are fed all the high-quality roughages they will eat plus a balanced grain mixture, fed according to their milk production, then production and feed are in balance.

Cows differ as individuals; probably no two are alike. They vary in their ability to produce, their ability to reproduce, their desire to eat, and in many other ways.

A good caretaker knows his herd so thoroughly that he is acquainted with the individual characteristics of the cows and adjusts his methods of feeding and management accordingly. The owner must be familiar with many facts in order to properly feed his milk cows.

He must train himself to be a close observer so that an abnormal condition can be quickly detected and corrected. Regardless of the method of feeding used, it is of first importance that the correct nutrients be fed in sufficient amounts.

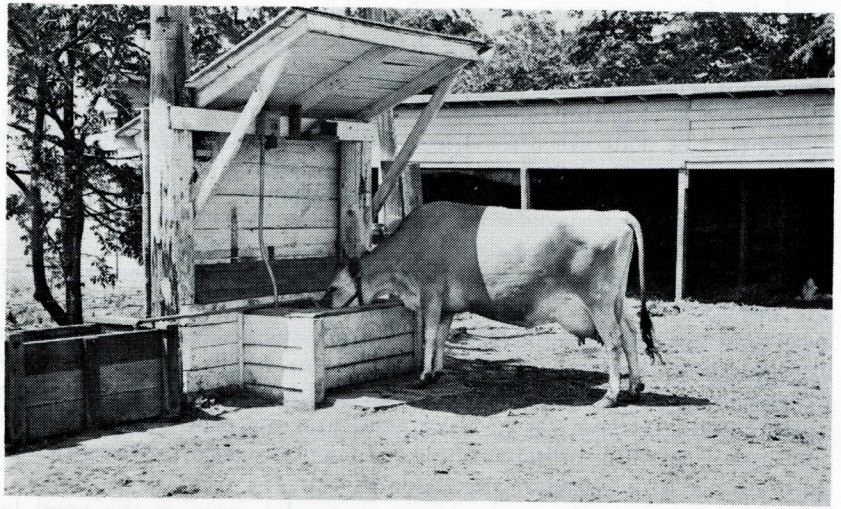
NUTRIENTS

The nutrients in feeds which perform specific functions in the cow's body and in milk production are water, carbohydrates, fats, proteins, minerals and vitamins. Each nutrient is important and the absence of one might interfere with normal body functions and milk production.

Except for vitamins, deficiencies in the nutrient content of the ration usually results in reduced milk yield rather than a change in composition.

Water

Water makes up 70 to 80 per cent of the cow's body, carries the digested food materials into the body, carries waste products away,



The water level in the small rectangular, insulated trough where the cow is drinking is regulated by a float. In the winter, water temperature is maintained at 38 to 44 degrees F. by a heating element made from soil-heating cable and regulated by a thermostat. In the summer, water is placed in the larger tank on the left.

helps control body temperature and makes up about 87 per cent of milk.

For each gallon of milk a cow produces, she needs 3 to 5 gallons of water. Cows drink more water when they have free access to it. Water should be fresh and clean. In the winter, water should be free from ice. It is not necessary to warm water, but the temperature should be maintained above freezing. The consumption of water will vary with seasonal temperatures and the kind of feeds eaten.

Carbohydrates

The grains produced on Nebraska farms are excellent sources of carbohydrates. The sugar, starches and woody or fibrous materials of the plants are the carbohydrates. Carbohydates are separated into two classes of substances. The first group, called "crude fiber," includes the carbohydrates which are relatively insoluble. The second group are the more soluble carbohydrates and are called nitrogen-free extract. In this group are included the starches, the sugars, and the organic acids like acetic and lactic acids in silage. In addition, small quantities of fiber may be included in the second group.

Crude fiber is less digestible and contains less available energy, than the nitrogen free extract.

Carbohydrates fed in excess of current needs are converted into body fat.

Commercial feed labels generally show the carbohydrates as crude fiber and nitrogen-free extract. Carbohydrates are used for energy and milk production.

Fat

Generally carbohydrates and fats are spoken of as one, because they both serve the same purpose. Although the two are interchangeable, there is two and one-fourth times more energy in fats than in carbohydrates. Fats are often listed on the label by manufacturers as "fat," "crude fat," or "ether extract." Practically all the home-grown grains contain sufficient fats for practical feeding.

Proteins

The proteins are of importance in dairy cattle feeding because they are essential for life. The amount of protein in a feed is generally expressed as crude or total protein. Not all the crude or total protein is digestible; therefore, the protein content might be expressed as "digestible protein." For example: In Table 3 of this bulletin the total protein of barley is 12.7 per cent; and the digestible protein is 10.0 per cent. The protein content of suggested grain rations in this bulletin has been based on digestible protein.

A good source of protein is young, tender grass or the good legume roughages. As the grasses and legumes mature, the protein content declines. Alfalfa, cut when it is not over one-tenth in bloom, is higher in protein content than when more mature. About 75 per cent of the protein is in the leaves of the legumes.

Cottonseed meal, linseed meal, soybean meal and gluten meal are all rich sources of protein and are used to supplement grains.

Minerals

The body of a dairy cow contains many minerals. Two or three are needed in rather large quantities. Common salt is a necessity. Milk cows need one or two ounces daily. This can be supplied by adding one pound of salt to every 100 pounds grain mix. Coarse granulated salt placed in a tight box, conveniently located, and protected from the wind and rain, will supply a sufficient amount.

Salt blocks should be placed so they are sheltered from rain and snow. For insurance against the lack of trace minerals, it might be advisable to use trace mineralized salt. If mineralized salt is not used, then iodized salt is suggested to guard against possible deficiency symptoms.

Calcium and phosphorus are needed by dairy animals for bone, teeth, milk production, and for reproduction. Cows lacking in either or both of these minerals may show a depraved appetite by chewing on sticks, bones, or posts. They may also show a condition of rheumatism and may not reproduce normally.

Alfalfa and other legumes are rich in calcium. Wheat bran and cottonseed meal are both rich in phosphorus.

Steamed bone meal and di-calcium phosphate are excellent sources of both calcium and phosphorus. To supply these minerals, one pound of steamed bone meal or di-calcium phosphate can be placed in 100 pounds of the grain mix. For additional mineral, place equal

parts of steamed bone meal or di-calcium phosphate and salt in a box. Salt also should be provided in another box. If just one mixture is provided, use one part of the mineral to four parts salt. Steamed bone meal and di-calcium phosphate are not very palatable, and a grain mixture may not be eaten if the minerals make up over 1 to 2 per cent of the total. Some folks prefer to buy a commercial mineral mixture instead of preparing their own. If one buys a mixture, he should pay particular attention to the amounts of calcium, phosphorous, and/or salt it contains. The phosphorus content should be high—10 per cent or more. The calcium content should *not be more than twice the phosphorous content.*

The other minerals are needed in such small quantities that practically all of them will be supplied with a good ration of high-quality roughages and a balanced grain ration. To produce feed crops high in the essential nutrients, the fertility of the soil should be maintained at a high level.

Calcium and phosphorus are stored in the cow's body and used when the need is greatest. Probably at no time are the intake and use equal. When given an opportunity, cows can build up reserves of some minerals in their bodies. The reserves are usually accumulated from good nutritious pastures and during the period when the cows are dry.

Sometimes phosphorus is supplied from phosphate rock. When rock phosphate or any phosphorous supplement is used, it is necessary that the fluorine content be reduced below 0.1 per cent in the defluorinated phosphate.

Vitamins

Vitamins are highly complex organic compounds which are not classed with proteins, carbohydrates and fats. Most of the known vitamins have been discovered since 1911. Probably more vitamins and their functions will be discovered in future years. According to present knowledge, ruminating animals have the ability to make all the vitamins they need except vitamins A and D.

Vitamin A is necessary for growth and maintenance of health. This vitamin is found abundantly in green grasses, in the green leaves of roughages and in yellow corn. The forerunner of vitamin A is carotene which is found in green and yellow plants. The carotene content of alfalfa decreases with storage and exposure to rainy, damp weather. Cows store vitamin A within their bodies when the supply is abundant and use it when the supply decreases. After the long, winter feeding season and before grass starts in the spring, the vitamin A supply in a cow's system is at a low level. The vitamin A in milk increases and decreases with the cow's supply. Milk is highest in vitamin A when the pastures are green and lush, and lowest just before the pasture season starts. Because butterfat contains vitamin A, there is practically none in skim milk. Colostrum, or the first milk produced

after freshening, may be ten times as rich in vitamin A as later milk from the same cow.

Dairy animals on a vitamin A-deficient ration show certain characteristics. Night blindness is one of the first symptoms. Several stages of night blindness can be recognized and the condition may progress to total blindness unless the deficiency is corrected. Swelling of the legs and forequarters is often found in cattle deficient in vitamin A. In addition, there may be a nervous disorder displayed by a lack of coordination, staggering gait and spasms. A ration deficient in vitamin A may interrupt normal sexual activity. Cows may not conceive and if they do become pregnant, they either abort or bear weak or blind calves which often fail to survive. With the exception of new yellow corn, all farm grains are poor sources of vitamin A.

Vitamin D, absorbed by the animal's body from the sunshine, is necessary in the assimilation of calcium and phosphorus. Therefore, it becomes essential in the development of teeth and bone. Cows secure vitamin D from sunshine in the summer and from eating sun-cured roughages in the winter. Cows have the ability to store this vitamin in their bodies. The lack of vitamin D in the diet of young stock will cause rickets. Symptoms of rickets are enlarged joints (particularly the front knees), bent knees, loss of appetite, arched back, and stiffness.

Calves fed whole milk or commercial milk replacer diets will usually receive ample vitamin D; however, if a supplement is needed, cod liver or a vitamin oil is recommended.

The effect of vitamin E upon reproduction has been discussed a great deal, but there are no facts available showing that it influences reproduction in cattle. If it is needed in small quantities, the common feeds should supply an ample amount. Vitamins of the B complex are formed by the bacteria in the cow's paunch.

Cows which receive at least 50 per cent of their roughage as sun-cured hay or which are on pasture should receive ample amounts of needed vitamins.

ROUGHAGES

Pastures

Pastures which are well managed afford an excellent source of nutrients and usually at lower cost than the other forms of roughage. Dairy cattle need pastures that produce an abundance and grow rapidly; otherwise, sufficient forage for economical high production will not be consumed. When pastures grow slowly, it may be best to feed stored roughages such as hay and silage.

The use of pastures reduces the labor required to care for cows, provides a variety of feeds, furnishes protein and vitamin A, stimulates milk production and returns the manure directly to the soil. On Nebraska farms everything possible should be done to improve the quality of the pastures. Different parts of the state are adapted to

Cows harvesting bromegrass and alfalfa.

different plans, but the following basic principles apply to all farms.

1. Develop and manage pastures to produce the maximum amount of feed for the longest possible grazing season.

2. Use recommended grasses and legumes in the pasture mixture.

3. Use supplementary crops like rye and sudan grass during times when permanent pastures aren't producing enough feed.

4. Maintain soils that produce pastures in a high state of fertility by the application of manure and the necessary plant food elements.

5. Keep pastures free from weeds by proper weed control methods.

6. Do not graze pastures when grass is too short. Let grasses be 4 to 6 inches tall before grazing. Always maintain at least a 3-inch grass stubble. Sudan grass should be 12 to 15 inches tall before grazing.

Small grain, legumes and grasses can all be worked into a successful pasture plan. Rye seeded early in the fall with ample moisture will provide late fall and early spring pasture. Bromegrass and alfalfa seeded in the fall should be ready to pasture the following May if the moisture conditions are good. Second-year sweetclover is good to use in parts of Nebraska, particularly in the irrigated sections. Sudan grass is drought-resistant, and makes a good pasture in July and August. Do not pasture sudan after a frost or drought if new growth appears at the base of the plants. A pasture mostly of alfalfa is always hazardous because of the danger of bloat.

These precautions can be followed as insurance against bloat when legumes are grazed.

1. Always provide some dry roughage. This is a good practice on any kind of pasture. A rack in the pasture that is kept full of dry roughage at all times is a practice many dairymen successfully follow.

2. Feed animals dry roughages before they are permitted to graze legumes.

3. Do not turn animals on legumes after a rain or heavy dew.

4. Provide plenty of salt and water in the pasture.

5. Have material available that can be used for the treatment of bloat.

To guard against off flavors in milk, remove cows from pastures at least two hours before milking.

When cows are on pasture, give them plenty of salt, water and shade.

Green Chop Feeding

This method refers to a system of machine harvesting of forage and feeding it green and fresh. It may be fed to the dairy animals in self-feeding wagons or feed bunks.

Green chop feeding is only one way to manage pastures. Whether you graze or green chop your pastures, good all-around management practices need to be followed. Weed control, fertilization, irrigation, use of temporary pastures, proper choice of forage varieties, insect control, and the overall economics of pasture on your particular farm are all important factors to consider

Many dairy men will probably increase their net income more by improving on the grazing practices they now use rather than shifting to a new system. Changing to a new system usually calls for learning new management practices and for an overall higher level of management ability.

For more details on this system of feeding, secure EC 168, "Green Chop Feeding," from your County Agent.

The amount of feed consumed by cows on pasture depends on the size of the cows and the quality of the pasture. The biggest difference between the cost of pasture and the cost of hay is the cost of harvesting the hay. Cost account studies show that a logical charge for pasture is one-half the price of its hay-equivalent or hay-replacement value. The table on page 11 shows the estimated charge for pasture when good hay is worth various amounts per ton.

Soilage

Soilage (harvested green) feed is worth one-fourth the price of good hay. In estimating the capacity of wagons or feed carts, figure 20 pounds per cubic foot.

Succulent Roughages

Succulent roughages are corn, cane and grass silages, wet sugar beet pulp, and sugar beet top silage, or any roughage high in moisture. Corn and cane will yield more nutrients per acre when fed as silage than in any other way. Silages add variety to the ration, and may increase total roughage consumption.

Table for Estimating the Charge for Pasture

Quality of pasture				Price per ton of good hay		
Excellent	Good	Fair	Poor	$10	$15	$20
Ave. weight of cows in herd (lbs.)				Monthly charge for pasture		
1,400	.....	.....	.....	$3.25	$4.90	$6.50
1,300	.....	.....	.....	3.00	4.50	6.00
1,200	1,400	.....	.....	2.75	4.20	5.50
1,100	1,300	.....	.....	2.50	3.75	5.00
1,000	1,200	1,400	.....	2.25	3.40	4.50
900	1,100	1,300	.....	2.05	3.05	4.10
	1,000	1,200	.....	1.90	2.80	3.80
	900	1,100	1,400	1.65	2.50	3.30
		1,000	1,300	1.50	2.25	3.00
		900	1,200	1.40	2.05	2.80
			1,100	1.25	1.85	2.50
			1,000	1.15	1.70	2.30
			900	1.00	1.55	2.00

To use the table: ***Example***

1. **Make a careful estimate of the quality of the pasture** ..... **Good**
2. **Estimate the average body weight of the herd** **1,200**
3. **Determine the price of good hay** **$15**
4. **Locate the average body weight of the herd in the appropriate pasture column, and on the same line under price of hay will be found the monthly charge for pasture** **$3.40**

The table should be used as a guide. When cows do not have access to pasture day and night or when liberal amounts of hay and silage are bing fed, reduce the pasture charge proportionately.

About three pounds of silage is equal to one pound of a high-quality legume roughage. Large cows will eat 70 to 80 pounds of silage daily if it is the only roughage. It is better, however, to feed a conservative amount (35 to 40 pounds daily) for a longer period than to feed the greater amounts during the winter months or for a short period.

Silage can be kept for long periods, when properly preserved, and may be used when drought decreases feed supplies. Corn should be harvested for silage when the kernels are well dented, the silks are dry, and the three or four bottom blades or leaves are dry. Atlas or Leoti Red sorghums make excellent silage and should be placed in the silo when heads are in the medium-dough stage.

Producing some forage sorghums for silage is an insurance against drought. Mixing corn and forage sorghums in equal amounts makes better silage than sorghums alone. Corn and cane for silage should be harvested before frost. If the crop is killed by frost, it should be harvested immediately before the leaves become dry. Corn or sorghums that do not pack well should have water added.

Sugar beet tops make excellent silage and can be cured by stacking on well-drained ground. Slight spoilage occurs on the outside, but the inside of the stack makes high-quality silage. Silage from beet tops is

Harvesting Atlas sorghum for silage. The forage sorghums produce good yields of silage that is readily eaten by milk cows. The forage sorghums need to be harvested when the seeds are in the dough stage. Forage sorghums mixed with the entire corn plant will make a very palatable silage. Harvesting the corn or forage sorghum crop as silage produces more feed per acre than harvesting the crop in other ways.

more laxative than that from corn, and therefore more precaution should be taken in feeding it.

Sweet corn, after the ears are snapped for the cannery, makes good silage. Sweet corn silage is about 75 per cent as valuable as silage from well-eared corn.

Legumes, grasses and small grains make good silages. When unfavorable weather prevents harvesting and curing high-quality hay, it may be advisable to make it into silage. At other times, a mixture of grasses and legumes or cereal grains may make a better feed when conserved as silage than when cured as hay. For details about harvesting and conserving silage get Extension Circulars 130 and 131, entitled "Grass Silage Better than Poor Hay" and "Corn and Sorghum Silage." For information on the construction of silos, one is referred to Farmers' Bulletin, No. 1820, published by the United States Department of Agriculture and available at the offices of the county agricultural agents.

Silage should be fed after milking and preferably outside so that the silage will not cause off flavors in milk.

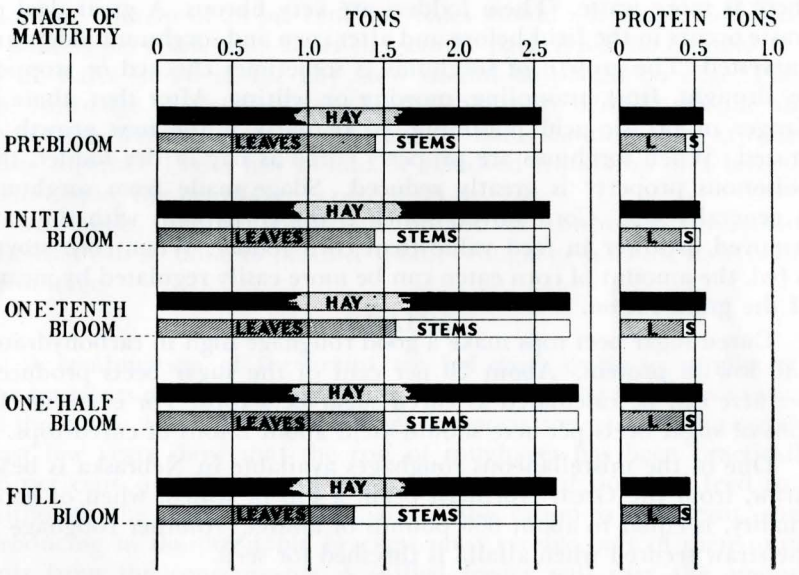
Dry Roughages

Hay is the basis for winter feeding. Climatic conditions, stage of maturity, methods of handling, and fertility of the soil influence the

quality of hay. Green, fine-stemmed, leafy alfalfa is the best roughage available in Nebraska. Regardless of the variety of legume or grass, the quality is best and the protein highest when it is harvested in an early stage.

The carotene, forerunner of vitamin A, is closely related to the green color; therefore, it is important to conserve the green hay. Brome and alfalfa mixture makes a good hay, but it is slightly lower in protein than alfalfa alone. Red clover is similar to alfalfa but slightly lower in protein and less palatable. The protein yield per acre is highest if red clover is cut when 50 per cent in bloom.

The Yields of Hay and Protein Per Acre Are Influenced by the Stage of Maturity at Which Alfalfa Is Cut.



The largest yields of high-grade hay are obtained if alfalfa is cut when one-tenth to one-half in bloom. The yield of protein per acre shows little variation during the prebloom, initial-bloom, tenth-bloom and half-bloom stages. At the half-bloom stage of growth of alfalfa about half the total hay consists of leaves, but they contribue approximately three-fourths of the total protein.

Sweetclover makes a fair roughage if cut before the plant is too large and stemmy. This legume is more difficult to cure properly.

Sweet clover hay and silage, which has undergone spoilage, may cause sweet-clover disease. The disease is caused by a poisonous compound, *dicoumerol,* formed from the coumarin in sweet clover that has molded or spoiled in storage. Animals eating sweet clover should not be dehorned because excess bleeding might take place at that time.

Soybean hay is high in protein, being equal to alfalfa. Soybeans make a good emergency hay crop but are more profitable when har-

vested for their beans. Soybeans are harder to cure properly than alfalfa.

Prairie hay or hay made from many of the native grasses is low in protein and calcium and not as palatable as the hay from legumes. The protein of the prairie or native grass hays is highest when cut at a very early stage. These hays can add a little variety to the cow's ration, but are best fed to calves. If fed to cows as all or part of the roughage, it is necessary to increase the amount of grain fed.

Sudan grass, millet, or oat hays are low in protein and minerals and are poor roughages for dairy cattle. They can be used in times of emergency, but results will be disappointing unless more grain is fed. Fodders from the sorghums are similar to sudan grass hay; however, there is more waste. These fodders are very fibrous. A great deal of waste occurs in the field before and after corn and sorghum fodders are harvested. The growth of sorghums is sometimes checked or stopped by drought, frost, trampling, mowing or wilting. After that, there is danger of prussic acid poisoning, particularly if the new growth is grazed. When sorghums are properly cured as hay or dry fodder, the poisonous property is greatly reduced. Silage made from sorghums is generally safe. Corn stover, which is the corn plant with the ears removed, is lower in feed value than corn fodder. When corn stover is fed, the amount of corn eaten can be more easily regulated by means of the grain ration.

Cured sugar beet tops make a good roughage high in carbohydrates and low in protein. About 20 per cent of the sugar beets produced per acre can be calculated as cured sugar beet tops. For example, 10 tons of sugar beets per acre should yield about 2 tons of cured tops.

One of the miscellaneous roughages available in Nebraska is bean straw, from the Great Northern bean, a ton of which, when of good quality, is equal to about 800 pounds of alfalfa. Another roughage is the straw secured when alfalfa is threshed for seed.

Grinding of hays or fodders for dairy cows is generally considered a poor practice. Dry roughages, which must be ground to be properly eaten, are undesirable for dairy cows. Furthermore, the cost of grinding usually exceeds the benefits obtained. Feeding cows finely ground roughage, and no unground roughages, may cause a marked drop in the milk fat test.

The importance of feeding roughages of high quailty cannot be too strongly emphasized. The total nutrients produced per acre are highest with the roughages. Hay improperly cured, which causes the leaves and color to be lost, is of inferior quality. Weeds reduce the quality of hay and pasture, and should be eliminated. The losses that occur in hay-making are: (1) Losses of leaves and other finer parts by shattering; (2) Losses by fermentation and bleaching; and (3) Losses of nutrients by leaching, owing to heavy rains.

Hay mowed very early in the morning is drier by evening than hay

mowed later or about noon. The practice of mowing hay early on a clear morning can contribute to better-quality hay.

The use of a hay crusher or crimper causes the stems of alfalfa and red clover plants to dry at about the same rate the leaves dry. This uniformity in curing makes it possible to shorten the curing time for hay and reduces shattering.

Baling hay from the windrow is becoming a common practice. Hay of good quality can be made with the windrow baler, if these precautions are followed:

1. Hay when baled should not contain more than 25 per cent moisture.
2. Hay should not be packed too tightly in the bale. With a moisture content of 25 per cent, the bales should not weigh more than 8 pounds per cubic foot. Drier hay can be packed a little tighter.
3. Bales stored in the hay mow should be placed on edge. Place the fold edge of one bale next to the chaff edge of the next one and with the alternate layers at right angles. Bales should not be crowded close together. Loose hay should be removed from atop of a layer of bales before the next layer is placed on it.

Although weather conditions cannot be controlled, everything else that can be done to produce quality roughage is to the dairyman's advantage.

GRAINS

A combination of the grains are fed dairy cattle to supplement the nutrients of the roughages. The costly part of the milk cow's ration is the grain. Dairy herd improvement association records during the past few years show that the cost of roughages has been practically 46 per cent, and the cost of grain 54 per cent of the total feed cost. Although the most expensive part of the ration is the grain, cows producing in the profitable brackets must receive part of their nutrients from the concentrates. A skilled feeder will vary the amount of the grain ration fed with the quality of roughage fed.

The grain ration should contain about 12 per cent digestible protein, be high in total digestible nutrients, and all the nutrients should be supplied at a minimum cost.

Corn is palatable and is usually one of the most economical sources of energy for the dairy ration. It is low in protein and minerals; however, yellow corn is a good source of Vitamin A. Corn should be coarsely ground. Corn and cob meal or ground ear corn contains about 90 per cent of the nutrients of ground shelled corn. This may be used in dairy rations to supply energy and bulk, replacing other bulky feeds.

Barley, when ground, crushed, or rolled, is an excellent feed for dairy cattle. When forming from 40 to 60 per cent of the concentrate mixture for dairy cows, ground barley has been equal to ground corn.

Oats are an excellent feed for dairy cows. They are bulky, palatable, and of the cereal grains, one of the highest in protein. Oats may safely constitute as much as 50 per cent of the concentrate mixture. Cows utilize oats best when crimped or ground.

Wheat is a little pasty or heavy, but is well liked by dairy cows. It has practically the same feed value as corn, but needs to be mixed with lighter feeds. Not over one-third of the grain ration should be wheat. Wheat should be coarsely ground or cracked.

Rye is equal to corn or wheat in feed value, but is not as palatable. Probably not over one-third of the ration should be rye. Rye seed is sometimes attacked by the ergot fungus, which changes the seed into a large black mass. This affected seed is poisonous to dairy animals if consumed in large amount.s

Grain sorghum has 95 to 100 per cent the feeding value of ground, shelled corn. If the grain is not ground, about one-half passes through the cow unchewed and undigested.

Sorghum head chops, obtained by grinding the entire heads, resembles corn and cob meal in composition and value, and can be substituted for corn and cob meal.

Soybeans are an excellent source of protein equal in value to linseed oil meal, when fed cracked or ground. Results show no harmful effects when soybeans are used liberally in the grain ration.

Culled beans, sorted out from first-quality beans in western Nebraska, are a good protein substitute. They have 50 per cent of the value of cottonseed meal, but should not make up more than one-fifth of the concentrate mixture. They are rather unpalatable unless mixed with other grains.

Custom grinding and mixing by portable mills may perform a useful service for the dairyman. Some elevators are equipped to grind, mix, and pellet a grain ration for the dairyman. During the process of grinding or when the grain is mixed after grinding, additional supplements can be added.

BY-PRODUCTS FEEDS

Many by-products are available on the market and are good feeds and should be included in the grain ration when favorably priced.

Wheat bran is bulky, well liked by cows, high in phosphorous, and a good source of protein. It makes an excellent feed for dairy cattle when mixed with home-grown grains. It has about the same feed value as oats and is a good substitute for them.

Linseed oil meal is the product left after oil is extracted from flax. It is an excellent source of protein, palatable and slightly laxative.

Cottonseed oil meal is slightly higher in protein than linseed oil meal but not as laxative or palatable. **Soybean oil meal** is the meal left after oil has been removed from the beans. It has about the same protein content as cottonseed oil meal, but is lower in phosphorus.

Safflower oil meal is manufactured in western Nebraska and is the product left after oil is removed from the safflower seed. Meal from the hulled seed is slightly higher than linseed meal in protein, while meal from the unhulled seed is about one-half as high.

Corn gluten meal is a by-product from the manufacture of starch. It is about the same as soybean oil meal in digestible protein but the protein is of lower quality.

Corn gluten feed is a by-product from the manufacture of corn starch, but should not be mistaken for corn gluten meal as it contains only 60 per cent as much digestible protein. It is slightly less palatable than corn, oats, and wheat bran and needs to be blended with other feeds.

Brewers' dried grain and **distillers' dried grain** are by-products from the manufacture of alcohol and liquors from corn, barley and other grains. Brewers' dried grain equals corn gluten feed in digestible protein, but is lower in total digestible nutrients. Brewers' dried grain is not very palatable and should not make up over one-third of the concentrates. Distillers' dried grain is relatively high in protein and high in fat. It is slightly superior to corn gluten feed. Other by-products secured from grains are malt sprouts and wet brewers' grain.

Dried sugar beet pulp is obtained by drying part of the residue left after sugar is extracted from beets. It may be dried with or without molasses. This feed is palatable, bulky, slightly laxative and keeps well in storage. It is high in carbohydrates, but relatively low in protein. Dried sugar beet pulp may be fed dry or soaked. It makes an ideal feed for filling show cattle.

Molasses is used as an appetizer. Sometimes it can increase the palatability of feeds. In general, the nutrients purchased in molasses are more costly than in grains.

One bushel of corn and 6.5 gallons of molasses are equal in feed value.

Urea is a manufactured nitrogen product which dairy cows can use as a source of protein. One pound of urea contains as much nitrogen as 6.4 pounds of cottonseed or soybean meal, but contains no other nutrients. One pound of urea plus 6 pounds of grain replaces 7 pounds of oil meal. Urea must be thoroughly blended and completely mixed with the grain. Urea should be fed at a rate not greater than 3 per cent of the concentrate mixture.

Also, *urea* should *not* form more than 5 to 10 per cent of supplemental protein mixtures or pellets, or the palatability may be much decreased. It should not be used in calf starter rations.

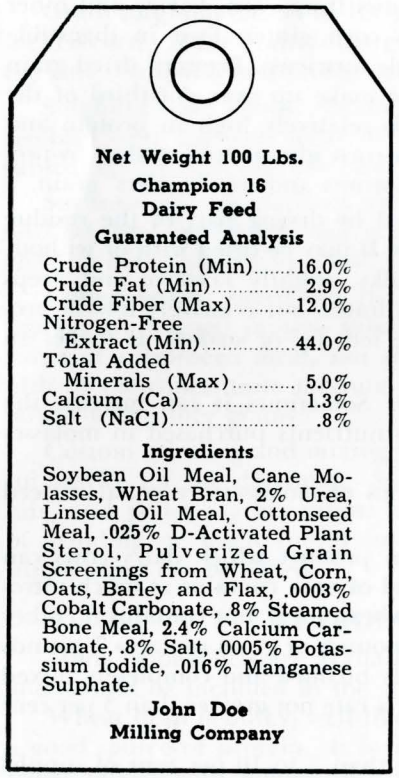
PREPARED DAIRY FEEDS

Many different commercial dairy feeds are sold on the market. The quality of the feeds varies. Some are of excellent quality and others of low quality. For individuals milking a few cows and buying

all their feed, perhaps it is justifiable to purchase a prepared feed.

Sometimes a dairyman milking many cows may be justified in purchasing feeds, particularly when a dairyman can buy large quantities in bulk.

Individuals who raise grains can most economically balance the grain ration with one of the high protein concentrates, such as soybean oil meal, cottonseed oil meal, linseed oil meal or corn gluten meal. Concentrates should be compared on the basis of digestible protein. The most important factor in purchasing supplements is the cost of a pound of digestible protein.



Net Weight 100 Lbs.

Champion 16
Dairy Feed

Guaranteed Analysis

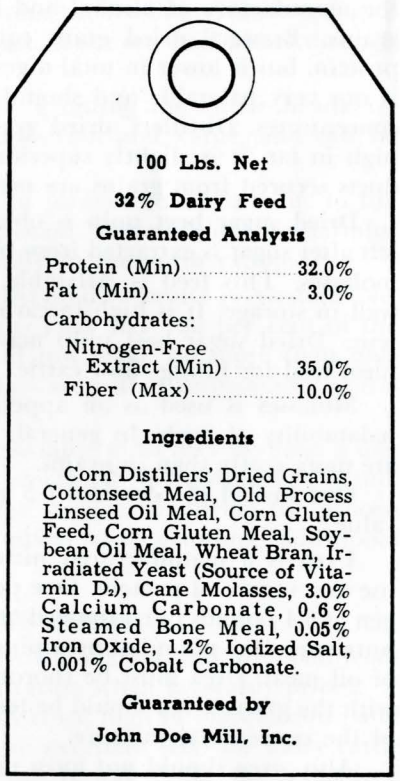
Crude Protein (Min)	16.0%
Crude Fat (Min)	2.9%
Crude Fiber (Max)	12.0%
Nitrogen-Free Extract (Min)	44.0%
Total Added Minerals (Max)	5.0%
Calcium (Ca)	1.3%
Salt (NaCl)	.8%

Ingredients

Soybean Oil Meal, Cane Molasses, Wheat Bran, 2% Urea, Linseed Oil Meal, Cottonseed Meal, .025% D-Activated Plant Sterol, Pulverized Grain Screenings from Wheat, Corn, Oats, Barley and Flax, .0003% Cobalt Carbonate, .8% Steamed Bone Meal, 2.4% Calcium Carbonate, .8% Salt, .0005% Potassium Iodide, .016% Manganese Sulphate.

John Doe
Milling Company

A tag from a sack that contains a medium amount of protein. Generally the fiber is higher than in the higher protein feeds. The feed also contains more grain screenings. The urea is a nonprotein nitrogen.



100 Lbs. Net

32% Dairy Feed

Guaranteed Analysis

Protein (Min)	32.0%
Fat (Min)	3.0%
Carbohydrates:	
Nitrogen-Free Extract (Min)	35.0%
Fiber (Max)	10.0%

Ingredients

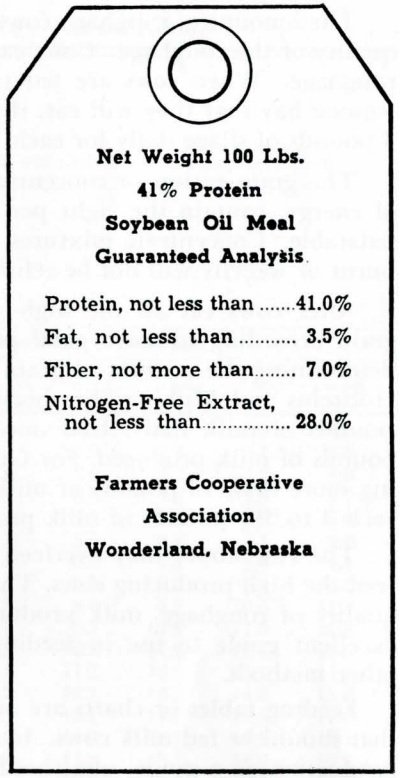
Corn Distillers' Dried Grains, Cottonseed Meal, Old Process Linseed Oil Meal, Corn Gluten Feed, Corn Gluten Meal, Soybean Oil Meal, Wheat Bran, Irradiated Yeast (Source of Vitamin D_2), Cane Molasses, 3.0% Calcium Carbonate, 0.6% Steamed Bone Meal, 0.05% Iron Oxide, 1.2% Iodized Salt, 0.001% Cobalt Carbonate.

Guaranteed by

John Doe Mill, Inc.

A tag from a sack of feed relatively high in protein. The analysis shows crude, not digestible nutrients. Generally the quantities of the ingredients are varied, depending upon their price.

Nebraska laws require that the manufacturers of commercial feeds and mineral mixtures label their products. The analysis placed on the feed tag shows the minimum amounts of crude protein, fat, and nitrogen-free extract contained in the feed. In addition, the maximum amount of fiber is listed. Between 75 and 85 per cent of the crude protein is digestible. For example, the crude protein in wheat bran is 16.4 per cent and the digestible protein is 13.3 per cent. This factor should be considered when determining the digestible nutrients contained in a sack of feed.



Net Weight 100 Lbs.

41% Protein

Soybean Oil Meal

Guaranteed Analysis

Protein, not less than	41.0%
Fat, not less than	3.5%
Fiber, not more than	7.0%
Nitrogen-Free Extract, not less than	28.0%

Farmers Cooperative
Association
Wonderland, Nebraska

A tag from a sack of soybean oil meal. The analysis lists crude rather than digestible nutrients. The carbohydrates are listed as Fiber and Nitrogen-Free Extract.

WINTER FEEDING

High-quality legume hay and possibly silage should be the foundation for feeding when very good pastures are not available. Cows will eat large quantities if the hay is of high quality. Hay should be fed liberally so that the cows can select the leaves and finer stems and not be required to eat parts of the stems that are coarse. Providing fresh hay and removing uneaten portions makes it possible for cows to eat larger amounts. Hay should be fed in large feed racks or roomy places where the cows can eat freely without disturbance. If only good-quality hay is fed, two to three pounds per 100 pounds of live weight is needed per day. This is the amount actually consumed, and does not include the hay which might be wasted.

Many dairymen consider silage an important part of the cow's ration. Silage is a succulent, laxative type of a roughage. About three pounds of silage will replace one pound of legume hay. If silage is the sole roughage, large cows can eat 100 pounds daily. It is best to feed both hay and silage in relationship with the available supply. For example, when the amount of hay is limited, feed more silage or vice versa.

The amount of roughage cows eat depends upon their size and the quality of the roughage. Cows eat more high-quality than low-quality roughage. When cows are fed twice a day, all the silage and good legume hay that they will eat, they take about one pound of hay and 3 pounds of silage daily for each 100 pounds of liveweight.

The grain ration or concentrate mixture should be a good source of energy, contain the right per cent of protein, be economical and palatable. Concentrate mixtures which become moldy, musty, rancid, burnt or weevily will not be relished by cows.

After cows eat all the high-quality roughage possible, then feed grain according to some good plan. Different rules can be used in determining the amount of grain to feed. For Ayrshires, Brown Swiss, Holsteins and Milking Shorthorns that are producing more than 18 pounds of milk daily, feed one pound of grain for each 3½ to 4 pounds of milk produced. For Guernseys and Jerseys that are producing more than 12 pounds of milk daily, feed one pound of grain for each 3 to 3½ pounds of milk produced.

The rule above may overfeed the low producing cows and underfeed the high producing cows. The detailed table on page 21, based on quality of roughage, milk production and butterfat percentage is an excellent guide to use in feeding grain, and is more accurate than other methods.

Feeding tables or charts are only guides as to the amount of grain that should be fed milk cows. In addition to using milk and butterfat production as a guide, one should take into consideration:

(1) Condition of cows. Thin cows need additional grain while fat cows should have less grain.

(2) Age of cows. Young cows that are growing and maturing need additional grain. Generally, cows will grow and mature until they are five to six years old.

(3) Quality of roughage. Use more grain with poor-quality roughage and less grain with high-quality roughage.

On page 22 are some suggested concentrate mixtures. These mixtures contain about 12 per cent digestible protein and can be fed with practically all combination of roughages. It is recognized that cows on poor-quality roughages will need more supplemental protein from the concentrates. In addition, more carbohydrate is also needed, since intake of poor-quality roughage is less than for good quality roughage. Both of these needs are met by feeding a larger quantity of this same concentrate mixture. This is illustrated in the table on page 21. A cow producing 33 pounds of 4 per cent milk, when fed poor roughage, should be fed 13.7 pounds concentrate—and when fed liberally of good roughage, requires only 7.6 pounds of concentrates.

If excellent quality roughages are fed all the time, it would be possible to decrease the protein by two or three per cent.

Grain Feeding Table For Cows Not On Pasture*

Hay equivalent consumed per 100 lbs. of live weight daily			Total pounds of grain mixture or concentrates to feed						
2½ lbs. Very liberal feeding of good roughage	2 lbs. Usual rate of feeding good hay or good hay and silage	Feeding scanty am't of good roughage or feeding poor roughage	Percentage of fat in milk						
Milk produced daily, pounds			3.0%	3.5%	4.0%	4.5%	5.0%	5.5%	6.0%
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
17	10	....	.....	.....	.....	1.9	2.2	3.1	3.5
19	12	....	.....	.....	1.6	2.8	3.2	4.2	4.6
21	14	....	1.5	2.0	2.4	3.8	4.2	5.3	5.7
23	16	9	2.3	2.8	3.3	4.7	5.2	6.3	6.8
25	18	11	3.0	3.6	4.2	5.6	6.2	7.4	8.0
27	20	13	3.7	4.4	5.0	6.5	7.2	8.4	9.1
29	22	15	4.5	5.2	5.9	7.5	8.2	9.5	10.2
31	24	17	5.2	6.0	6.8	8.4	9.2	10.5	11.3
33	26	19	6.0	6.8	7.6	9.3	10.2	11.6	12.5
35	28	21	6.7	7.6	8.5	10.3	11.2	12.7	13.6
37	30	23	7.4	8.4	9.3	11.2	12.2	13.7	14.7
39	32	25	8.2	9.2	10.2	12.1	13.2	14.8	15.8
41	34	27	8.9	10.0	11.1	13.1	14.2	15.8	17.0
43	36	29	9.6	10.8	11.9	14.0	15.1	16.9	18.1
45	38	31	10.4	11.6	12.8	14.9	16.1	18.0	19.2
47	40	33	11.1	12.4	13.7	15.9	17.1	19.0	20.3
49	42	35	11.8	13.2	14.5	16.8	18.1	20.1	21.5
51	44	37	12.6	14.0	15.4	17.7	19.1	21.1	22.6
53	46	39	13.3	14.8	16.3	18.7	20.1	22.2	23.7
55	48	41	14.1	15.6	17.1	19.6	21.1	23.3	
57	50	43	14.8	16.4	18.0	20.5	22.1		
59	52	45	15.5	17.2	18.9	21.4	23.1	Regardless of the	
61	54	47	16.3	18.0	19.7	22.4	amount of grain theoretically required by a cow,		
63	56	49	17.0	18.8	20.6	23.3			
65	58	51	17.7	19.6	21.4	24.2	she should not be fed		
67	60	53	18.5	20.4	22.3		more than she can safely		
69	62	55	19.2	21.2	23.2		handle.		
71	64	57	19.9	22.0	24.0				
73	66	59	20.7	22.8	24.9				
75	68	61	21.4	23.6	25.8				

* Courtesy, *Morrison's Feeds and Feeding* (22nd Edition).

Decide upon a good grain ration that will give you satisfactory results. It is not a good feeding practice to continuously change your grain ration. Of course, the grain ration should be kept economical. Therefore, it may be necessary to change grain rations at different times, depending upon prices.

By using different tables in this bulletin it is possible to determine the digestible protein percentage and its costs in the grain ration.

1. Multiply the per cent of digestible protein in each feed (see

Suggested Concentrate Mixtures

Feed	Mix #1	Mix #2	Mix #3	Mix #4	Mix #5	Mix #6	Mix #7	Mix #8
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Ground Corn	500	.....	200	.....	.....	300	.....	.....
Ground Corn and Cobs	.....	500	.....	.....	.....	.....	.....	.....
Ground Grain Sorghum	.....	.....	300	500	.....	.....	.....	.....
Ground Oats	200	200	200	200	300	.....	300	200
Ground Barley	.....	.....	.....	.....	450	400	500	450
Wheat Bran	200	150	200	200	200	200	100	.....
Dried Beet Pulp	.....	.....	.....	.....	.....	.....	.....	250
*High-protein Feed	100	150	100	100	50	100	100	100
	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Crude or Total Protein	14.4%	15.2%	15.1%	15.5%	14.8%	15.4%	16.0%	14.7%
Digestible Protein	11.6%	12.1%	12.1%	12.4%	11.8%	12.4%	12.8%	11.1%
Total Digestible Nutrients	75.2%	72.3%	75.2%	75.1%	73.3%	76.5%	74.4%	73.9%

* High-protein feeds include cottonseed-oil meal, corn gluten meal, linseed meal and soybean oil meal. In the eight rations shown above, soybean oil meal was used for calculating the per cent digestible protein and the total digestible nutrients.

table, pages 28 and 29) by the number of pounds of that feed in mixture.

2. Add the results.

3. Divide the sum by the total pounds of the mixture.

4. Multiply the result by 100, which will give the per cent of digestible protein.

EXAMPLE

Feed	Pounds	Per Cent Digestible Protein	Pounds Digestible Protein
Ground corn	500	6.7	33.5
Ground oats	200	9.4	18.8
Wheat bran	200	13.3	26.6
Soybean oil meal	100	37.0	37.0
	1000		115.9

115.9 ÷ 1000 = .1159
.1159 x 100 = 11.59 or 11.6 per cent

This grain ration contains 11.6 per cent digestible protein and would be good to feed with roughages of average quality. The protein level can be increased or decreased by changing the amount of the high-protein concentrate (soybean oil meal). Replacing part of the protein concentrate with grains will lower the protein level, or the protein level can be raised by replacing the grains with protein concentrate.

To determine what feeds to buy, compare the cost of one pound of digestible protein in different feeds. The protein concentrates are purchased to supplement the home-grown grains and to increase the protein content of the grain mixture.

1. Determine the cost of the feeds on a hundredweight basis.
2. Determine the pounds of digestible protein in the feed.
3. Divide the cost by the pounds of digestible protein in the feed.

EXAMPLE

Feed	Pounds	Cost	Per Cent Digestible Protein	Pounds Digestible Protein
Cottoneed oil meal	100	$4.00	37.4	37.4

$4.00 ÷ 37.4 = .1070 or 11¢ cost per pound digestible protein.

SUMMER FEEDING

The summer feeding program is usually based on pasturing or green-chop feeding.

Early in the spring the grasses are high in protein and carotene. As they mature in July and August, the protein and carotene content decreases. Cows on good pastures early in the season will need less grain than later in the season when the amounts of feed from the grasses decrease.

Turn cows on pastures in the spring when the grass is 4 to 6 inches tall and thick enough so that cows can fill in a short time. Grasses at first are watery and dry feed is needed when they are changed from winter to summer feeding.

Feeding of medium quality grass hay to cows while on pasture may help prevent bloat but will likely reduce pasture consumption. Pasture quality must be frequently noted since the nutrient content and consumption of grasses will vary greatly during the pasture season. The grain ration fed should be similar to those presented previously.

FEEDING DRY COWS

Four to six weeks before cows go dry and during their dry period, they should gain in weight. This is the time to get cows in good condition for freshening. During this period increase the grain they are fed.

Cows dry two months or less probably cannot be over-conditioned during that period. The amount of grain fed daily will depend upon the size of the cow, her condition and the length of the period she is dry. Most cows can use three to six pounds of grain daily. One needs to use his best judgment in getting cows in the proper condition before freshening. Large cows, thin in flesh, with a short rest period (three to six weeks) may need 10 to 12 pounds grain daily to properly pre-

Grain Feeding Guide For Cows On Pasture

Quality of pasture			Total pounds of grain mixture or concentrate to feed						
Excellent	Good	Fair	Percentage of fat in milk						
Milk Produced Daily			3.0%	3.5%	4.0%	4.5%	5.0%	5.5%	6.0%
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
22	13	....	.....	.....	.....	.....	.....	.....	1.2
24	15	....	.....	.....	.....	.....	1.2	2.0	2.3
26	17	....	.....	.....	.....	1.9	2.2	3.1	3.5
28	19	10	.....	.....	1.6	2.8	3.2	4.2	4.6
30	21	12	1.5	2.0	2.4	3.8	4.2	5.3	5.7
32	23	14	2.3	2.8	3.3	4.7	5.2	6.3	6.8
34	25	16	3.0	3.6	4.2	5.6	6.2	7.4	8.0
36	27	18	3.7	4.4	5.0	6.5	7.2	8.4	9.1
38	29	20	4.5	5.2	5.9	7.5	8.2	9.5	10.2
40	31	22	5.2	6.0	6.8	8.4	9.2	10.5	11.3
42	33	24	6.0	6.8	7.6	9.3	10.2	11.6	12.5
44	35	26	6.7	7.6	8.5	10.3	11.2	12.7	13.6
46	37	28	7.4	8.4	9.3	11.2	12.2	13.7	14.7
48	39	30	8.2	9.2	10.2	12.1	13.2	14.8	15.8
50	41	32	8.9	10.0	11.1	13.1	14.2	15.8	17.0
52	43	34	9.6	10.8	11.9	14.0	15.1	16.9	18.1
54	45	36	10.4	11.6	12.8	14.9	16.1	18.0	19.2
56	47	38	11.1	12.4	13.7	15.9	17.1	19.0	20.3
58	49	40	11.8	13.2	14.5	16.8	18.1	20.1	21.5
60	51	42	12.6	14.0	15.4	17.7	19.1	21.1	22.6
62	53	44	13.3	14.8	16.3	18.7	20.1	22.2	23.7
64	55	46	14.1	15.6	17.1	19.6	21.1	23.3	Regard-
66	57	48	14.8	16.4	18.0	20.5	22.1	less of the	
68	59	50	15.5	17.2	18.9	21.4	amount of grain theor-		
70	61	52	16.3	18.0	19.7	22.4	etically required by a cow		
72	63	54	17.0	18.8	20.6	23.3	she should not be fed		
74	65	56	17.7	19.6	21.4	more than she can safely handle.			

Courtesy "Morrisons Feeds and Feeding," 22nd Edition.

pare them for their next lactation. In addition, dry cows need all the good-quality roughage they will eat.

Just before and after calving reduce the amount of grain fed.

Immediately after calving, feed cows bran made into a mash with warm water. If bran is not available, use ground oats.

Supply the laxative feed for a few days after calving, changing over gradually to the regular grain ration. It will take a few weeks before cows are producing their maximum, and during this period the grain should be gradually increased.

FEEDING HERD BULLS

The herd bull needs the proper feeds for development and normal functions. Mature bulls on good pastures need only small quantities of grain, while young growing bulls will need larger amounts. Bulls that are confined need good roughage. There is always danger of bulls developing too much of a paunch. A mixture of alfalfa and prairie hay is better than alfalfa alone.

The amount of grain will depend upon the size and condition. About 0.5 pound grain is needed for every 100 pounds live weight. A 1600-pound bull should have about 8 pounds grain plus 16 to 18 pounds of hay daily.

SQUARE METHOD FOR BALANCING RATIONS

A rapid procedure for the calculation of simple grain mixtures is found in the square method. It is most readily used when only one protein supplement is mixed with grains, but its use may be extended to include a number of feeds in the mixture.

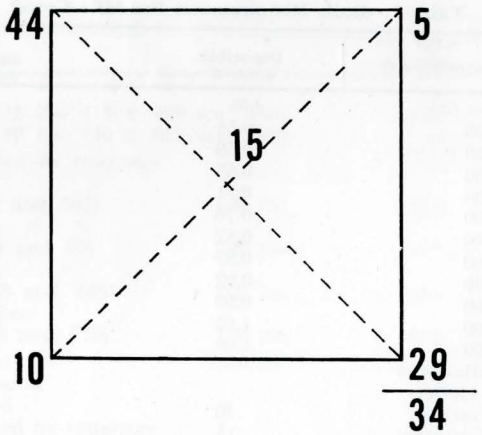
Example: The available feeds are shelled corn, oats, and soybean oil meal. The quantity of corn available is about twice that of oats. The total protein content of corn is 8.7 per cent; of oats, 12.0 per cent; and of soybean oil meal, 44.0 per cent. How much of each feed is needed to make a mixture containing 15 per cent protein?

Solution: First, compute the protein content of a mixture of 2 parts by weight of corn and 1 part oats –

200 pounds corn, 8.7% protein = 17.4
100 pounds oats, 12.0% protein = 12.0
29.4

$\frac{29.4}{300} \times 100 = 9.8$ or 10 per cent protein in corn-oats mixture

Second, construct a square, and insert the protein percentages: Place the desired percentage of protein in the center of the square. Subtract along diagnoal lines, and place differences (omitting plus or minus signs) at the right. Add the differences.



Third, compute the amount of each feed required to make one ton of mixture:

$\frac{5}{34} \times 2000 = 294$ pounds soybean oil meal

$\frac{29}{34} \times 2000 = 1706$ pounds corn-oats mixture

The calculations show that 294 or 300 pounds of soybean oil meal containing 44 per cent protein and 1706 or 1700 pounds of corn-oats combination, containing 10 per cent protein, will provide a mixture containing 15 per cent protein. Two-thirds of the corn-oats combination will be corn (1138 pounds)—and one-third will be oats (568 pounds).

Three or more grains may be used instead of only corn and oats. If this is done, proceed as before, first finding the average protein content of the grain mixture and using this figure at the side of the square. Two or more protein supplements may be combined in the same way.

THE USE OF FEEDING STANDARDS

For practical purposes it is not necessary to prepare rations for individual cows. A ration prepared for the entire herd using the maximum amounts of roughages and home-grown grains balanced with protein concentrates to fit the kind of roughage available will fulfill practically all the needs for feeding dairy cows in Nebraska.

There is some value in knowing how to balance rations for individual cows on the basis of digestible protein and total digestible nutrients. This method can be followed for the entire herd if a ration is balanced for an average cow in the herd.

First, cows use feed for the maintenance of their bodies. Table 1 shows the amounts of digestible protein and total digestible nutrients required for the maintenance of cows of different sizes.

Table 1.—Daily Requirements For Milk Cows*

Maintenance (recommended)	Digestible protein	Total digestible nutrients
Weight of cow (lbs.)	*Lbs.*	*Lbs.*
800	0.54	6.5
900	0.59	7.2
1000	0.65	7.9
1100	0.71	8.6
1200	0.76	9.3
1300	0.82	10.0
1400	0.87	10.6
1500	0.92	11.3
1600	0.98	11.9
1700	1.03	12.6
1800	1.08	13.2
Additional Allowance For Milking Heifers		
First Lactation	.30	1.8
Second Lactation	.15	0.9

* From Morrison's "Feeds and Feeding," 22nd Edition.

In the requirements of digestible protein and total digestible nutrients, there is some variation; however, those shown in Table 1 are the amounts advised under usual conditions.

In addition to maintenance requirements, nutrients are required

for milk production. In Table 2 are the recommended nutrients for each pound of milk containing different percentages of butterfat.

Table 2.—Requirements For Milk Production*

Milk production (recommended)	Digestible protein	Total digestible nutrients
	Lbs.	*Lbs.*
For each 1 lb. of 3.0% milk	0.043	0.28
For each 1 lb. of 3.5% milk	0.046	0.30
For each 1 lb. of 4.0% milk	0.049	0.32
For each 1 lb. of 4.5% milk	0.052	0.35
For each 1 lb. of 5.0% milk	0.056	0.37
For each 1 lb. of 5.5% milk	0.059	0.40
For each 1 lb. of 6.0% milk	0.062	0.42

* From Morrison's "Feeds and Feeding," 22nd Edition.

The daily requirements for a cow that weighs 1200 pounds and produces 48 pounds of 4 per cent milk are as follows:

	Digestible protein	Total digestible protein
1200-lb. cow maintenance (from table 1)	.76	9.3
48 lbs. of 4 per cent milk (from table 2) (48 x .049 and 48 x .32)	2.35	15.4
Total requirements	3.11	24.7

Now that the total requirements are known, the problem is to furnish them from the feeds available or purchased. Available are alfalfa hay, corn silage and grain mix No. 1 (page 22).

Nutrients furnished by different amounts of feeds are as follows:

		Digestible protein	Total digestible Nutrients
		Lbs.	Lbs.
Alfalfa hay—15 lbs. (15 x .109 and .507)		1.63	7.6
Corn silage—40 lbs. (40 x .012 and .183)		.48	7.3
Nutrients furnished by roughage		2.11	14.9
Ground corn (500 x .067 and .801)	500 lbs.	33.5	400.5
Ground oats (200 x .094 and .70)	200 lbs.	18.8	140.2
Wheat bran (200 x .133 and .669)	200 lbs.	26.6	133.8
Soybean oil meal (100 x .370 and .779)	100 lbs.	37.0	77.9
Total	1000 lbs.	115.9	752.4
Nutrients in 1 pound		.116	.752
Nutrients required		3.11	24.7
Nutrients furnished by roughage		2.11	14.9
Nutrients required from grain		1.00	9.8
Nutrients furnished by 12 lbs. grain		1.39	9.1
Difference		+ .39	− .7

This combination of feeds, fed as recommended, furnishes slightly more protein and slightly less total digestible nutrients than required for a mature cow but is close enough for practical purposes.

Table 3.—The Amounts of Total Protein, Digestible Protein and Total Digestible Nutrients in Common Feeds

Feeds	Constituents per 100 lbs. feed		
	Total Protein	Digestible Protein	Digestible Nutrients
Concentrates	Lbs.	Lbs.	Lbs.
Barley	12.7	10.0	77.7
Beans, field or navy	22.9	20.2	78.7
Beet pulp, dried	8.8	4.1	68.7
Beet pulp, molasses, dried	8.9	5.9	72.4
Brewers' grain, dried	25.6	20.7	65.3
Corn—and cob-meal	7.4	5.4	73.2
Corn, dent, (Grade No. 2)	8.7	6.7	80.1
Corn gluten feed	24.8	21.3	74.1
Corn gluten meal	43.2	36.7	79.7
Cottonseed (45% protein and over)	45.6	37.4	75.1
Distillers dried corn grain with solubles	26.6	19.4	82.1
Distillers dried rye grain	24.4	14.6	59.1
Flaxseed	24.0	21.8	108.3
Grain sorghums	10.9	8.5	79.4
Linseed meal	35.2	30.6	75.5
Linseed meal (37% protein or over)	37.5	32.6	78.0
Malt sprouts	26.4	20.3	70.9
Milo Head Chops	9.2	7.0	74.3
Molasses, Beet	8.4	4.4	60.8
Molasses, Cane	3.0	0.0	53.7
Oats	12.0	9.4	70.1
Oats, light weight	12.0	8.3	59.8
Rye	12.6	10.0	76.5
Safflower seed oil meal (hulled seed)	42.5	37.4	69.4
Safflower seed oil meal (from unhulled seed)	21.5	17.2	50.1
Soybean oil meal	44.0	37.0	77.9
Soybean seed	37.9	33.7	87.6
Tankage (60%)	59.4	50.5	65.8
Wheat bran	16.4	13.3	66.9
Wheat shorts (brown)	16.4	13.9	74.2
Wheat, average all type	13.2	11.1	80.0
Dry roughages			
Alfalfa	15.3	10.9	50.7
Alfalfa meal, dehydrated	17.7	12.4	54.4
Alfalfa leaf meal	21.1	16.0	56.7
Alfalfa and bromegrass hay	11.8	7.6	47.9
Clover, red	12.0	7.2	51.8
Corn fodder	6.8	3.3	53.9
Corn stover	5.8	2.0	45.5
Millet hay (Japanese)	8.3	5.1	47.3

Table 3.—Continued

Feeds	Constituents per 100 lbs. feed		
	Total Protein	Protein	Digestible Nutrients
		Lbs.	Lbs.
Oat hay	8.2	4.9	47.3
Oat straw	4.1	0.7	44.7
Prairie hay	5.7	2.1	49.6
Sorghum fodder	6.2	3.3	52.4
Soybean hay	14.4	9.6	49.0
Soybean straw	4.0	1.2	38.5
Sudan grass hay	8.8	4.3	48.5
Sweetclover hay	13.5	9.4	47.3
Timothy hay	6.5	2.9	48.9
Succulent feeds			
Alfalfa, green	4.6	3.5	14.8
Beet pulp, wet	1.5	0.8	8.9
Blue grass, green (Kentucky pasture)	5.5	4.1	20.7
Brewers' grains, wet	5.7	4.6	16.6
Corn cannery refuse	2.0	1.1	11.5
Mangels, roots	1.3	0.9	7.1
Potatoes	2.2	1.3	17.4
Silage, alfalfa (wilted)	6.3	4.3	21.5
Silage, alfalfa (high in water)	3.7	1.9	12.7
Silage, corn	2.3	1.2	18.3
Silage, corn and sorghum	1.9	1.0	16.4
Silage, grass, considerable legumes, and grain added	5.1	3.2	20.6
Silage, sorghum (grain)	2.1	1.1	17.8
Silage, sorghum (sweet)	1.6	0.8	15.2
Silage, soybean	4.2	2.6	15.0
Sugar beet tops	3.8	2.6	14.9

* Courtesy Morrison's Feeds and Feeding 22nd Edition.

Relationship Between Price Per Bushel and 100 Pounds of Common Feeds

Price per bushel	Cost per 100 pounds when a bushel weighs				
	32 lbs.	48 lbs.	56 lbs.	60 lbs.	70 lbs.
	(Oats)	(Barley)	(Shelled corn or rye)	(Soybeans or wheat)	(Ear corn)
.55	1.72	1.15	.98	.92	.79
.60	1.88	1.25	1.07	1.00	.86
.65	2.03	1.35	1.16	1.08	.93
.70	2.19	1.46	1.25	1.17	1.00
.75	2.34	1.56	1.34	1.25	1.07
.80	2.50	1.67	1.43	1.33	1.14
.85	2.66	1.77	1.52	1.42	1.21
.90	2.81	1.87	1.61	1.50	1.29
.95	2.97	1.98	1.70	1.58	1.36
1.00	3.13	2.08	1.79	1.67	1.43
1.05	3.28	2.19	1.88	1.75	1.50
1.10	3.44	2.29	1.96	1.83	1.57
1.15	3.59	2.40	2.05	1.92	1.64
1.20	3.75	2.50	2.14	2.00	1.71
1.25	3.91	2.60	2.23	2.08	1.74
1.30	4.06	2.71	2.32	2.17	1.86
1.35	4.22	2.81	2.41	2.25	1.93
1.40	4.37	2.92	2.50	2.33	2.00
1.45	4.53	3.02	2.59	2.42	2.07
1.50	4.69	3.12	2.68	2.50	2.14
1.55	4.84	3.23	2.77	2.58	2.21
1.60	5.00	3.34	2.86	2.66	2.28
1.65	5.16	3.44	2.95	2.75	2.35
1.70	5.31	3.54	3.04	2.84	2.42
1.75	5.47	3.64	3.13	2.92	2.50
1.80	5.62	3.74	3.22	3.00	2.58
1.85	5.78	3.85	3.31	3.08	2.65
1.90	5.94	3.95	3.40	3.17	2.72
1.95	6.10	4.06	3.49	3.25	2.79
2.00	6.26	4.16	3.58	3.34	2.86

RATIONS CAN BE BALANCED FOR PRACTICAL PURPOSES BY USING THE INFORMATION BELOW

This combination of grains and other feeds is based on the premise that dairymen will feed an average quality roughage like alfalfa hay and corn or sorghum silage. Your choice will be determined by the feeds you have on hand and by those you can get. See Groups of Feeds A, B, C, and D below. When feed of any group is called for, one or more may be used. If possible, use three or more feeds in your mixture.

Good Mixed Hay or Legume Hay,
Fed with or without Sorghum or Corn Silage

Mix No. 1	*Mix No. 2*	*Mix No. 3*
750 lbs. — A Feed	600 lbs. — A Feed	600 lbs. — A Feed
250 lbs. — D Feed	200 lbs. — B Feed	400 lbs. — C Feed
	200 lbs. — D Feed	
Mix No. 4	*Mix No. 5*	*Mix No. 6*
700 lbs. — A Feed	700 lbs. — A Feed	600 lbs. — A Feed
100 lbs. — B Feed	150 lbs. — C Feed	100 lbs.— B Feed
200 lbs. — D Feed	150 lbs. — D Feed	200 lbs. — C Feed
		100 lbs. — D Feed

ADD—1 lb. salt and 1 lb. steamed bone meal to 100 lbs. grain mix.

A FEEDS—Low in Protein
Farm-Grown Grains

Ground Corn	Ground Barley
Corn & Cob Meal	Ground Grain Sorghum
	Ground Oats

B FEEDS—Medium in Protein
16% Dairy Feed

Wheat Bran	Wheat Middlings

C FEEDS—Medium-Rich in Protein

Corn Gluten Feed	24% Dairy Feed
Dried Brewers' Grains	Distillers' Dried Grains

D FEEDS—Rich in Protein

Linseed Meal	Corn Gluten Meal
Soybean Oil Meal	Cottonseed Meal
Ground Soybeans	32% to 34% Dairy Feed

SUMMARY

Various kinds of crops are produced for feeding milk cows in Nebraska. The conditions upon farms also vary from one year to another. These different crops and varying conditions cause a difference in milk cow feeding methods. In addition, the changing price of feeds and milk or cream may alter feeding methods some years.

After one has considered these variable factors, it is advisable to adopt a good, sound dairy animal feeding program that can be successfully followed. A dairyman needs to improve feeding and management practices adapted to his place instead of making continual radical changes.

Milk cows should be fed all the high-quality roughage they will eat plus a balanced grain ration. The amount of the concentrate mixture fed should be according to—(1) milk production, (2) butterfat test, (3) age of cow, (4) condition of cow and (5) quality of roughage. The total protein in the grain mixture should be about 15 per cent and the digestible protein from 11 to 12 per cent. The protein content may be reduced if the roughage is continuously of high quality. Dairymen need to guard against overfeeding low producers and underfeeding high producers.