7-1925

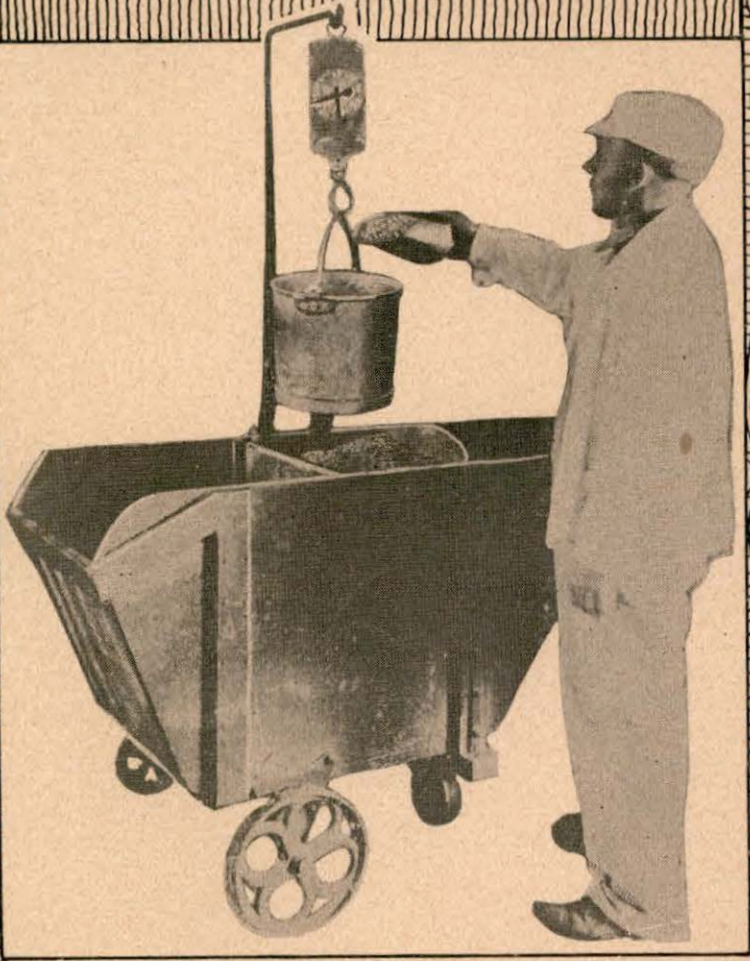
Feeding the Dairy Cow

H. P. Davis

Circular 29 July, 1925

Feeding the Dairy Cow

By H. P. DAVIS



The University of Nebraska
COLLEGE OF AGRICULTURE
Experiment Station
E. A. Burnett, LINCOLN Director

CONTENTS

Feeding the Dairy Cow

H. P. DAVIS

Cows produce milk from feed and water only. Therefore feed in proper quantity and quality is usually the limiting factor governing a cow's production up to the limit of her capacity. Since dairy cows are kept primarily for their milk production, it is essential that it be not limited because of insufficient or improper feed. Successful feeding, therefore, consists in getting the largest quantity of milk from the cows at the least cost and at the same time maintaining their health and vigor for future milking periods.

FEED PLENTY

A dairy cow is like a gasoline engine, feed may be compared with the fuel or gasoline, and the milk with its butterfat and other solids may be likened to the work which an engine performs. A cow, like the engine, uses fuel to produce work. A certain quantity of fuel or gasoline is always used to start the engine and to operate it when running idle. Likewise, a certain proportion of the feed is used by the cow to keep her body in running order, pumping blood, chewing, digesting food, and making body repairs. Such feed is said to be used for maintenance. Only when more feed than is needed for maintenance is given can the cow be expected to produce milk. She will, however, often do so for a time at the expense of her body reserve. Economy indicates that a cow should be fed above maintenance and in proportion to the yield of milk up to the point where more feed produces no more milk.

A very few people may feed a dairy cow so much that she will put on fat. Even that feed is seldom wasted, since the cow stores it for later use. Under all conditions liberal feeding pays. Remember that in feeding a dairy cow not only the present but future milking or lactation periods must be provided for. A cow should be so fed that she will have a succession of good milking periods and not one good one followed by several poor ones while she is recuperating because of a depleted body reserve. It is feasible and possible for a cow to produce well for half a dozen successive lactation periods with no "off years" if she is properly fed. The first principle of feeding is — plenty of feed.

SUMMER FEEDING

PASTURE

NATIVE PASTURE

Nature has provided an ideal assortment of foods for the dairy cow in the various pasture grasses. They are succulent, nutritious, and palatable and are known to stimulate milk production and to promote good health. Unfortunately, natural pastures are available in this climate for but a comparatively short period each year. For the remainder of the year they must be supplemented or other feeds provided, if the milk flow is to be maintained. In the case of very high producing cows, pastures will not furnish sufficient nutrients for the greatest production because the capacity of the cow is so limited that she cannot consume a sufficient quantity of such bulky feed.

In summer the biggest problem in feeding for most dairy herds is the furnishing of sufficient good pasture. Nebraska is a large state and pastures naturally vary in the different sections. In the eastern part of the state, blue grass is abundant, while in the western part other grasses such as the bluestems and grama make up the native pasture. Wherever the native grass gives sufficient pasturage it is unnecessary to consider other pasture crops. Many sections, however, have insufficient pasturage from native pastures, and in these cases other pasture crops are often a great improvement. Pasture reduces to the minimum the labor required to feed and care for cows and if not too costly fits well into a farm plan.

SWEET CLOVER PASTURE

Sweet clover, a close relative of alfalfa, has done very well as a pasture crop in many sections of Nebraska. Seeded with an alfalfa drill or broadcast, at the rate of 10 to 16 pounds per acre, as early in the spring as the ground can be put into condition, it furnishes considerable pasture under favorable weather conditions the first season. Scarified seed of the biennial sweet clover should be used and the second year a better pasture will be obtained. Experience has indicated that to use this crop successfully it must be pastured fairly close to the ground. By alternating pastures frequently, several milking cows can be kept on an acre. Of course it is understood that the amount of moisture will govern the closeness of pasturing to a great extent. If not

cropped fairly close, it grows up very woody and is not palatable. Sweet clover stands dry weather well and usually responds to late summer showers.

Practice has indicated that cattle should not be turned into sweet clover pasture until it is 6 to 8 inches high. A certain amount of caution must be used in pasturing sweet clover to guard against possible bloating. When animals are first turned on sweet clover pasture it is a good plan, the first week, to let them fill up on hay each morning before turning them on the pasture. After that there will usually be no trouble. It is always well, however, to let a heavy dew dry off a little before turning animals into the pasture. Sweet clover will furnish a large amount of pasture if properly handled.

SUDAN GRASS PASTURE

Sudan grass is another excellent summer pasture crop that stands dry weather well and furnishes a great deal of feed. Usually Sudan grass is seeded with a grain drill after corn planting time at the rate of about 25 to 30 pounds per acre. Under favorable conditions it will be ready to pasture in a month to a month and a half. It should not be pastured until the growth is 10 to 12 inches high. Sudan grass may be allowed to grow up and be cut for hay if it is not needed for pasture.

COST OF PASTURE

Pasture is not always the cheapest feed. Its cost depends upon the number of animals that it will carry, the price of land, the lay of the land, and the price of labor. Few ordinary native pastures will carry one cow per acre for the pasture season. They usually range from that number to one cow for 10 acres in some dry, sandy regions. If, for example, land is worth $100 per acre and 2 acres are necessary to pasture a cow 150 days, then the interest charge at 6 per cent against the pasture would be $12 for the season. This would make a charge of 8 cents per day for interest, exclusive of taxes and upkeep. In the table below this is illustrated.

Under most circumstances it is not profitable to pasture cows when the daily rental exceeds the cost of other feed plus labor. There is much land that either because of the roughness of its surface or because of the character of its soil should always be in grass. Such cases make it necessary to retain pasture even tho other considerations would indicate some other crop.

TABLE 1.— *Interest cost of pasture per cow per season. (Interest at 6 per cent.)*

Acres per cow	Value of land per acre				
	$25	$50	$100	$150	$200
1	$1.50	$ 3.00	$ 6.00	$ 9.00	$12.00
1½	2.25	4.50	9.00	13.50	18.00
2	3.00	6.00	12.00	18.00	24.00
2½	3.75	7.50	15.00	22.50	30.00
3	4.50	9.00	18.00	27.00	36.00
3½	5.25	10.50	21.00	31.50	42.00
4	6.00	12.00	24.00	36.00	48.00

TABLE 2.— *Interest cost of pasture per cow per day on basis of Table 1 with a pasture season of 150 days.*

Acres per cow	Value of land per acre				
	$25	$50	$100	$150	$200
	Cents	Cents	Cents	Cents	Cents
1	1	2	4	6	8
1½	1½	3	6	9	12
2	2	4	8	12	16
2½	2½	5	10	15	20
3	3	6	12	18	24
3½	3½	7	14	21	28
4	4	8	16	24	32

SOILING CROPS OR SOILAGE

Soilage is essentially the growing of a green crop and harvesting and transporting it to a convenient place for feeding. It is quite evident that by this practice greater yields may be obtained from a given area of ground, since there is no waste of feed due to tramping or to covering by manure. On the other hand, soilage requires much labor, usually both horse labor and man labor, and unless these are available at low cost, the system is not as economical as the use of pasture. It is also often difficult to arrange for a succession of crops that will be ready for feeding thruout the season. Probably a succession of crops beginning with sweet clover pasture

followed by oats or rye and then Sudan grass would carry thru the summer in Nebraska to good advantage.

SUMMER SILO

Any silo may be used for feeding in summer, but smaller silos are sometimes used for that purpose, not being opened until the early summer. The smaller diameter is desirable in order that there may be a smaller area or surface of silage exposed to the air. Where pastures are likely to be short or unreliable, silage is an economical and useful feed for summer.

PASTURE SUPPLEMENTS

Pasture may be supplemented in many different ways — with soiling crops, silage, hay, and grain. If possible it is best to use a succulent feed, as a soiling crop or silage, since such a feed is more likely to maintain milk production. Good hay is very useful, but it is hard to maintain milk flow on poor pasture supplemented only with hay. Grain is very useful to feed either in addition to pasture for cows giving a large flow of milk or supplemental to poor or dried-up pastures. Naturally, the quantity fed depends upon the milk flow and the quality of the pasture. Many dairymen who have high-producing cows feed some grain, even with good pasture.

GUIDE FOR FEEDING OF GRAIN WITH PASTURE

A guide that has proved useful when feeding grain with good pasture is as follows:

JERSEY OR GUERNSEY COWS

Up to 20 lbs. milk daily	1 lb. grain to 7	lbs. of milk
With good pasture no grain need be fed to cows of that production.		
20 lbs. to 25 lbs. milk daily	1 lb. grain to 6	lbs. of milk
25 lbs. to 30 lbs. milk daily	1 lb. grain to 5	lbs. of milk
30 lbs. to 35 lbs. milk daily	1 lb. grain to 4½	lbs. of milk
35 lbs. or above milk daily	1 lb. grain to 4	lbs. of milk

HOLSTEIN, AYRSHIRE, OR SHORTHORN COWS

Up to 25 lbs. milk daily	1 lb. grain to 8	lbs. of milk
Many dairymen feed no grain under 25 lbs. of milk.		
25 lbs. to 30 lbs. milk daily	1 lb. grain to 7	lbs. of milk
30 lbs. to 35 lbs. milk daily	1 lb. grain to 6	lbs. of milk
35 lbs. to 40 lbs. milk daily	1 lb. grain to 5½	lbs. of milk
40 lbs. or above milk daily	1 lb. grain to 5	lbs. of milk

For cows of medium to low production it probably does not pay to feed grain with good pasture. For merely supplementing short pasture, the following grain mixtures have been found useful:

GRAIN MIXTURES FOR PASTURE SUPPLEMENTS

Mixture No. 1.— Per cent digestible protein, 10.4		
Corn meal	50	lbs.
Wheat bran	100	lbs.
Oats (ground)	100	lbs.
Mixture No. 2.— Per cent digestible protein, 12.2		
Corn meal	100	lbs.
Wheat bran	100	lbs.
Linseed (oil) meal (old process)	25	lbs.
Mixture No. 3.— Per cent digestible protein, 10.8		
Corn-and-cob meal	100	lbs.
Corn oil cake meal	100	lbs.
Oats (ground)	100	lbs.
Mixture No. 4.— Per cent digestible protein, 11.4		
Corn meal	100	lbs.
Alfalfa meal	100	lbs.
Corn oil cake meal	100	lbs.

For high-producing cows it may be found advisable to increase the protein percentage in the grain mixture fed as a supplement in order to obtain the largest production. It pays to feed a good cow to the limit of her capacity. It does not pay to feed a poor cow at all.

WINTER FEEDING

Feeding dairy cows in the winter time or when they are not on pasture is more complicated. The principles involved are the same, namely, the furnishing of nutrients of the proper kind and quantity to the cow at the lowest cost. Usually the basis of feeding is the dry roughage produced on the farm. This usually consists of hay or fodder or both. Such feed is bulky and consequently costly to ship and some of it has little market value. Economy demands that it be utilized to the best advantage on the farm. Hay and fodder furnish the backbone of the ration, and about them the remainder is built so as to furnish a complete whole. If possible, some succulent feed or a substitute for succulence should be furnished. Naturally silage is the most common source of succulence. Roots, such as mangels or sugar beets, are just as useful but usually are a little more expensive.

ROUGHAGE

Roughage may be described as coarse feed that contains a relatively low quantity or percentage of nutrients. It includes the hays, straws, various kinds of dry fodder, and various

kinds of silage. Usually roughage is divided into 2 classes: dry roughage, which includes hays, straws, and dry fodders; and succulent roughage, which includes the silages, wet beet pulp, etc. Roots are sometimes classed as succulent roughage.

DRY ROUGHAGE

Dry roughage may again be divided, depending upon its protein content, into the legume hays and the non-legume hays, straws, and fodders.

LEGUME HAYS

Legume hays, all members of one family, are noted for their high protein content. Since protein is one of the most expensive parts of the ration for dairy cows, it is important to consider the quantity which can be obtained from the hay. The common legume hays are alfalfa, red clover, crimson clover, alsike clover, Japan clover or lespedeza, sweet clover, cowpea, and soy bean. While not of equal value for dairy cattle feeding, they may well be grouped together. Alfalfa and red clover are usually preferred by feeders because of their palatability and high feeding value. Cowpea and soy bean hay, altho somewhat coarser, are usually relished by dairy cows. Sweet clover, unless cut while short and young, is likely to be stemmy and will not be eaten well.

NON-LEGUME HAYS

Non-legume hays include prairie, millet, timothy, cane or sorghum, feterita, milo, Sudan grass, cereal hays, and native grass hays. Their quality depends to a large extent upon the conditions under which they are grown. They do not contain as much protein and hence are not so valuable as the preceding group for feeding to milk cows.

DRY FODDERS AND STRAWS

Dry fodders and straws depend for their quality upon the conditions of growth and harvesting, as well as upon the kind of plant. Corn stover, as corn stalks without the ears are called, makes excellent feed if properly handled. If allowed to be exposed to the weather for a considerable time in the fall and winter, much of the nourishment is lost. Oat and rye straws are fairly good feeds, while wheat and barley straws usually have a very low feeding value. Nevertheless, straw can often be used as a part of the roughage with economy.

QUANTITY OF DRY ROUGHAGE TO FEED

The quantity of dry roughage eaten by a milking cow depends upon her size, the quantity of milk she is producing, the other feeds she is receiving, the kind and quality of the roughage, and the weather. Only an approximate standard of feeding can be stated.

(1) DRY ROUGHAGE ALONE

When hay or dry roughage is fed alone, a cow will consume from 2.5 to 3.8 pounds of hay or dry roughage per day for each 100 pounds of live weight. In other words, a 1,000-pound cow will consume between 25 and 38 pounds of roughage per day.

(2) DRY AND SUCCULENT ROUGHAGE

When hay or dry roughage and silage are fed, a cow will consume from 1.5 to 2.5 pounds of hay or dry roughage per day for each 100 pounds of live weight when receiving between 3.0 and 4.5 pounds of silage per day for each 100 pounds of live weight. In other words, a 1,000-pound cow will vary between 15 and 25 pounds of hay or dry roughage when receiving 30 to 45 pounds of silage per day.

(3) DRY ROUGHAGE AND GRAIN

When hay or dry roughage is fed, and grain is fed according to the milk yield, a cow will consume between 1.5 and 2.5 pounds of hay or dry roughage per day for each 100 pounds of live weight, in addition to the grain.

(4) DRY AND SUCCULENT ROUGHAGE AND GRAIN

When hay and dry roughage and silage are fed and grain is fed according to milk yield, a cow will consume between 0.6 and 1.8 pounds of hay or dry roughage per day for each 100 pounds of live weight when she is receiving 2 to 4 pounds of silage per day for each 100 pounds of live weight and grain in proportion to the milk yield.

The above is intended as a general guide to feeding, since the conditions under which the feeding is done will often require variations. It is always good practice to feed all the hay or dry roughage that the cow will clean up.

SILAGE

A certain amount of juiciness or succulence is desirable in a dairy ration if maximum milk production is to be obtained. Silage consists of any finely cut green fodder packed in a

container from which the air is excluded, to be used out of season. Many crops are used for silage, but corn is the predominant silage crop in the United States. Other crops commonly used for silage are the sorghums, both the saccharine (sweet) and the non-saccharine varieties. The first group includes the canes, while the latter group includes feterita, milo, Sudan grass, etc. Many of the hays, such as alfalfa, cowpea, and soy bean, and such crops as oats and peas are used to fill the silo. The best silage is made from a crop that contains a moderate percentage of sugar. Too much sugar tends to produce sour silage and too little sugar in a crop fails to allow for the development of enough acid to properly preserve the silage. Many other materials, such as apple pomace, sunflowers, etc., are made into silage with fair results.

The quantity of silage to feed varies greatly with the kind of silage, the other feeds, and the cow. In general the following are guides to the quantity of silage that should be fed milking cows:

(1) SILAGE ALONE

When silage alone is fed (not a desirable practice), a cow will eat from 4.5 to 6.0 pounds per day for each 100 pounds of live weight.

(2) SILAGE AND DRY ROUGHAGE

When silage and hay or dry roughage are fed, see page 10.

(3) SILAGE, DRY ROUGHAGE, AND GRAIN

When silage, dry roughage, and grain are fed, see page 10.

On the average 2.75 to 3.00 pounds of good corn silage contains the same quantity of total nutrients as 1.00 pound of a good legume hay. The comparison does not hold true for the protein.

ROOTS

Roots are chiefly used to supply succulence in the dairy ration. Mangels, half-sugar beets, sugar beets, red beets, turnips, rutabagas, and carrots are common roots used for feed. Care must be used not to feed rutabagas and turnips before milking, as they sometimes flavor the milk. Mangels and half-sugar beets are popular for feeding in this state. They usually give the best yield of any of the roots. Large roots must be chopped or cut before feeding to cattle. Roots, usually very palatable, stimulate the flow of milk out of all proportion to their food value.

The quantity of roots fed to a milking cow depends upon the kind of roots, the other feeds, and the individual cow.

(1) ROOTS ALONE

A cow fed roots alone will eat 5.5 to 7.5 pounds per day for each 100 pounds of live weight. (Not a desirable practice.)

(2) ROOTS AND DRY ROUGHAGE

A cow fed dry roughage and roots will consume between 1.8 and 3.0 pounds of dry roughage and from 3.5 to 6.0 pounds of roots per day for each 100 pounds of live weight.

(3) ROOTS, DRY ROUGHAGE, AND GRAIN

A cow fed dry roughage, roots, and grain will consume daily between 0.6 and 1.8 pounds of dry roughage or hay and 2.5 to 5.0 pounds of roots for each 100 pounds of live weight. In addition she should be fed grain in proportion to the milk yield.

GRAIN CONCENTRATES

Cereal grains and concentrates, as the various by-products of milling and oil extraction are sometimes called, are becoming more and more important in dairy cattle feeding. The primeval cow that roamed the plains and forest produced only enough milk to feed her calf for a month or two. Thru centuries of breeding and selection the present productive dairy cow has been developed. The primeval cow of bygone centuries and the poor scrub of today do not require any concentrated feed; they can eat enough coarse fodder or roughage to supply all their needs. In fact, any concentrated feed given them is practically wasted. But the highly developed dairy cow of today cannot eat enough roughage to produce her maximum yield of milk and butterfat. Since man has developed an abnormal animal, he must feed her well if she is to be profitable. It is therefore necessary to give more concentrated feed, a large quantity of nourishment in smaller bulk. The place of grain in the ration for the good dairy cow of today is to supply her needs for maximum production when fed with roughage.

Grain being concentrated nourishment is usually more expensive than roughage. It should, therefore, be used as needed and not wasted. All roughages should be raised on the farm and as far as feasible the grains should also be home grown. With home-grown roughages available, a grain mixture can be constructed that will balance with the roughage to meet all the needs of the milking cow.

BALANCED RATION

A balanced ration is one that exactly meets the daily needs of the dairy cow, both for maintenance of her body and for production of milk. In practice, then, the grain mixture is made up to balance the roughage in order to make a completely balanced ration. There are a number of constituents in a ration but the more important are protein, carbohydrates, fat, and minerals. In general, the problem of balancing a ration consists in furnishing a proper amount of protein in proportion to carbohydrates and fat.

NEED OF PROTEIN

Protein is needed by the animal to make blood, muscle, and milk, and to carry on the other body functions. It also is vitally essential to the continued health of the cow and also to her future milk production. A deficiency in protein is probably one of the most important factors in limiting the milk production. It is not economical to limit a cow's milk production by failure to feed enough protein.

USE OF CARBOHYDRATES AND FATS

Carbohydrates and fats are used by the cow to supply energy (power to do work) to eat, walk, and make milk and to keep herself warm in the winter. They are also useful for making fat and for other body needs. A cow needs a definite quantity of carbohydrates and fat, but since they are both used for the same purpose it is easier in practice to consider them together. Fats are two and a quarter times as valuable as carbohydrates. In the figures for total nutrients in Table 3, the fats, multiplied by two and a quarter, are added to the carbohydrates and the protein is also combined in the figures.

Under ordinary feeding conditions, a dairy cow may eat enough to obtain a sufficient quantity of carbohydrates and fat from almost any class of feeds to meet the needs for her body and for milk production. Because of the fact that most of the common feeds available do not contain a large enough percentage of protein, it is often impossible for a cow giving a good flow of milk to eat enough to get the necessary protein. Unless the owner makes up a grain ration containing a larger proportion of protein, a high-producing dairy cow may be starved for the want of it. So far nothing has been found to take its place. Protein, however, may take the place of carbo-

hydrates and fat, but it is almost always the most expensive ingredient, and consequently is seldom used in their place.

BALANCING A RATION BY MEANS OF THE GRAIN MIXTURE

Balancing a ration for ordinary feeding consists in making up a grain mixture to feed with the available roughage that will supply the needs of any cow in the herd when fed in proportion to milk yield. For this purpose all roughage may be divided into 3 classes: high protein, medium protein, and low protein:

HIGH PROTEIN ROUGHAGE

High protein roughage consists of the legume hays, such as alfalfa, the clovers, cowpea, soy bean, etc. Such a group requires a grain mixture that contains between 12 and 14 per cent protein.

MEDIUM PROTEIN ROUGHAGE

One-half of the roughage belongs to the high protein class and one-half to the low protein class. Examples, alfalfa hay and silage; clover and timothy hay; prairie and alfalfa hay; clover hay and corn stover. The percentage of protein in the grain mixture may vary between 14.5 and 17.5.

LOW PROTEIN ROUGHAGE

Low protein roughage consists of prairie, native, millet, sorghum, and Sudan grass hays and such cereal hays and straws as oats, wheat, rye, and barley. The protein in the grain mixture may vary from 18 to 22 per cent. Low protein roughage requires a high percentage of protein in the grain mixture if a proper balance is to be maintained. To obtain this, a large proportion of some high protein concentrate is needed in the grain, which may tend to upset the physiological balance and make the mixture too laxative or too costive. Therefore it is desirable to use roughage from the first two groups.

CHEAPEST PROTEIN

Since low cost is of great importance in economical feeding, it is essential to consider which grains or concentrates will furnish protein at the lowest cost. Table 3 shows how to figure the cost of 100 pounds of protein in the different feeds. The cost may be determined for any feed by dividing the cost of 100 pounds of the feed by the protein content in per cent. For example, when wheat bran, which on the average has a

protein content of 12.5 per cent (.125), is worth $25 per ton or $1.25 per 100 pounds, the cost of 100 pounds of protein is $1.25 \div .125 = 10$ or $10 per 100 pounds of protein in bran. It is usually economical to use home-grown grains as far as possible.

BULK

Bulk plays an important part in the digestion of ruminants, particularly of cows. A grain mixture one-half of which is light and bulky in character is more easily digested and is less likely to cause digestive troubles. Consult Table 3 for information as to the bulkiness of feeds.

PALATABILITY

Palatability, as a factor in feeding, is usually underestimated by most feeders. It is nevertheless of much importance, since the more a good cow eats, up to her producing limit, the greater the production. At least one-half of the grain mixture should be of grains or concentrates that are listed as palatable.

PHYSIOLOGICAL EFFECT

Feeds have various effects upon the animal body. Some are laxative, some constipating, some affect the color, texture, and composition of the butterfat. In general only a limited quantity of either constipating or laxative feeds should be included in the grain mixture. A good rule to follow is not to have either a constipating or a laxative feed make up more than one-fourth of the mixture. Only limited quantities of concentrates that affect the butterfat should be given. See Table 3.

MINERALS ARE NECESSARY

A cow needs plenty of phosphates and lime for bone, blood, and milk production. Where good legume hay is available there is seldom a lack of lime in the ration. In certain sections, however, phosphates and lime are particularly important since the native feeds are low in these substances. In such cases 1 per cent of finely ground steam bone meal, preferably that from gelatine manufacture, may be added to the grain mixture. One per cent of salt is commonly added to grain mixtures. Charcoal, altho not a mineral, is frequently added for the purpose of absorbing gas in the stomach. In sections where there is trouble with goitre, potassium iodide may be used in limited quantities.

PRACTICE IN MAKING GRAIN MIXTURES

For general farm use, it is not practical to obtain great accuracy in the quantities of protein and carbohydrates and fat needed to make an exact balance. Since there is seldom a deficiency in carbohydrates and fat when the cow has all the roughage that she can eat, a roughly balanced ration may be obtained by balancing the protein of the grain mixture to go with the roughage and disregarding the carbohydrates and fat. For low- to medium-producing cows good alfalfa hay and corn meal make up a reasonably good ration. To go with alfalfa hay, a grain mixture can be made up of corn, oats, bran, and oil meal. By referring to Table 3 we get the following figures for protein:

100 lbs. corn	7.1 lbs.	digestible protein
100 lbs. oats	9.7 lbs.	digestible protein
100 lbs. wheat bran	12.5 lbs.	digestible protein
100 lbs. linseed oil meal	30.2 lbs.	digestible protein
400 lbs. of mixture	59.5 lbs.	digestible protein

It might be mentioned that digestible protein is that protein available for the use of the animal. All protein is not digested by cows, so that the figures for protein printed on a sack of concentrates are always higher than the figures given here, the difference running from 1 per cent to 5 or 6 per cent in some feeds. Under "Balancing a Ration" it was stated that a grain mixture to balance with alfalfa or a legume hay should contain from 12 per cent to 14 per cent of digestible protein. Then if we were to consider a mixture made up of these 4 feeds it would contain $59.5 \div 400 = .149$ or 14.9 per cent protein. With excellent alfalfa hay this could be reduced to 13.0 per cent if desired, altho a little extra protein would not be harmful. Suppose it were to be reduced by the addition of corn:

400 lbs. mixture	59.5 lbs. protein
100 lbs. corn	7.1 lbs. protein
500 lbs. mixture	66.6 lbs. protein

$66.6 \div 500 = .1332$ or 13.3 per cent. In other words, a mixture of:

200 lbs. corn	14.2 lbs. protein
100 lbs. oats	9.7 lbs. protein
100 lbs. wheat bran	12.5 lbs. protein
100 lbs. linseed oil meal	30.2 lbs. protein
500 lbs. mixture	66.6 lbs. protein
	= 13.3 per cent protein

In selecting the feeds, consult Table 3 to get protein as cheaply as possible. Keep in mind also bulkiness, palatability, physiological effect, and mineral content.

Such a mixture as just described, when fed in the proportion of 1 pound of grain to each 3 or 4 pounds of milk produced, or 7 pounds of grain for each pound of butterfat produced by the cow, together with all the alfalfa hay she will eat, will make a very good balanced ration. It is bulky, palatable, has the proper laxative effect, and when fed with alfalfa hay has a liberal amount of lime and phosphoric acid (phosphates).

If the roughage were prairie hay, the requirement for protein in the grain mixture would be between 18 and 22 per cent. With corn, oats, bran, and oil meal available, a mixture to balance with prairie hay would be as follows:

100 lbs. corn	7.1 lbs. protein
100 lbs. oats	9.7 lbs. protein
100 lbs. wheat bran	12.5 lbs. protein
100 lbs. linseed oil meal	30.2 lbs. protein
400 lbs. mixture	59.5 lbs. protein

59.5 ÷ 400 = .149 or 14.9 per cent. Add 150 pounds oil meal (45.3 lbs. protein) = 550 lbs. mixture, having 104.8 lbs. protein. 104.8 ÷ 550 = .1905 or 19.05 per cent.

In other words, a grain mixture composed of 1 part corn, 1 part oats, 1 part bran, and 2½ parts oil meal would balance pretty well with good prairie hay if fed in proportion to milk production. With any low protein roughage, either it is necessary for the grain mixture to contain a very high percentage of protein or one must feed more liberally of a lower protein ration. With low protein roughage and a lower protein ration, feed 6 pounds of grain to each pound of butterfat.

It is comparatively easy to balance a grain mixture for any kind of roughage. If the roughage is low grade, use a higher protein percentage in the grain mixture. Always keep in mind rules for balancing a ration when making up the grain mixture.

GRAIN MIXTURES FOR DIFFERENT ROUGHAGES

A series of grain mixtures suitable for use with different classes of roughage is given for convenience.

HIGH PROTEIN ROUGHAGE

PROTEIN IN GRAIN MIXTURES, 12 TO 14 PER CENT

	Pounds protein
Mix. 1.— Protein, 13.32%.	
200 lbs. corn	14.2
100 lbs. oats	9.7
100 lbs. wheat bran	12.5
100 lbs. linseed oil meal	30.2
500 lbs. mixture	66.6

	Pounds protein
Mix. 2.— Protein, 13.45%.	
100 lbs. barley	9.0
100 lbs. oats	9.7
100 lbs. wheat bran	12.5
300 lbs. corn oil meal	49.5
600 lbs. mixture	80.7

	Pounds protein
Mix. 3.— Protein, 13.51%.	
200 lbs. corn-and-cob meal	12.2
200 lbs. oats	19.4
100 lbs. wheat bran	12.5
100 lbs. cottonseed meal	37.0
600 lbs. mixture	81.1

	Pounds protein
Mix. 4.— Protein, 13.36%.	
300 lbs. hominy feed	21.0
100 lbs. oats	9.7
100 lbs. wheat bran	12.5
100 lbs. cottonseed meal	37.0
600 lbs. mixture	80.2

	Pounds protein
Mix. 5.— Protein, 13.50%.	
300 lbs. corn	21.3
100 lbs. alfalfa meal	10.2
100 lbs. wheat bran	12.5
100 lbs. cottonseed meal	37.0
600 lbs. mixture	81.0

	Pounds protein
Mix. 6.— Protein, 13.49%.	
100 lbs. corn-and-cob meal	6.1
100 lbs. oats	9.7
100 lbs. wheat bran	12.5
150 lbs. gluten feed	32.4
450 lbs. mixture	60.7

	Pounds protein
Mix. 7.— Protein, 13.62%.	
200 lbs. barley	18.0
100 lbs. oats	9.7
100 lbs. alfalfa meal	10.2
100 lbs. linseed oil meal	30.2
500 lbs. mixture	68.1

	Pounds protein
Mix. 8.— Protein, 13.02%.	
200 lbs. corn-and-cob meal	12.2
100 lbs. alfalfa meal	10.2
100 lbs. wheat bran	12.5
100 lbs. linseed oil meal	30.2
500 lbs. mixture	65.1

	Pounds protein
Mix. 9.— Protein, 13.20%.	
100 lbs. corn	7.1
100 lbs. oats	9.7
100 lbs. alfalfa meal	10.2
150 lbs. gluten feed	32.4
450 lbs. mixture	59.4

MEDIUM PROTEIN ROUGHAGE

PROTEIN IN GRAIN MIXTURES, 14.5 TO 17.5 PER CENT

	Pounds protein
Mix. 10.— Protein, 16.57%.	
100 lbs. corn	7.1
100 lbs. oats	9.7
100 lbs. wheat bran	12.5
150 lbs. linseed oil meal	45.3
450 lbs. mixture	74.6

	Pounds protein
Mix. 11.— Protein, 16.24%.	
100 lbs. barley	9.0
100 lbs. wheat bran	12.5
100 lbs. corn oil meal	16.5
200 lbs. gluten feed	43.2
500 lbs. mixture	81.2

	Pounds protein
Mix. 12.— Protein, 16.58%.	
100 lbs. corn-and-cob meal	6.1
100 lbs. oats	9.7
200 lbs. wheat bran	25.0
125 lbs. cottonseed meal	46.25
525 lbs. mixture	87.05

	Pounds protein
Mix. 13.— Protein, 16.55%.	
100 lbs. hominy feed	7.0
100 lbs. oats	9.7
100 lbs. wheat bran	12.5
100 lbs. cottonseed meal	37.0
400 lbs. mixture	66.2

	Pounds protein
Mix. 14.— Protein, 16.70%.	
100 lbs. corn	7.1
100 lbs. alfalfa meal	10.2
100 lbs. wheat bran	12.5
100 lbs. cottonseed meal	37.0
400 lbs. mixture	66.8

	Pounds protein
Mix. 15.— Protein, 16.20%.	
100 lbs. corn-and-cob meal	6.1
100 lbs. corn oil meal	16.5
100 lbs. wheat bran	12.5
250 lbs. gluten feed	54.0
550 lbs. mixture	89.1

	Pounds protein
Mix. 16.— Protein, 16.49%.	
100 lbs. barley	9.0
100 lbs. oats	9.7
100 lbs. alfalfa meal	10.2
150 lbs. linseed oil meal	45.3
450 lbs. mixture	74.2

	Pounds protein
Mix. 17.— Protein, 16.46%.	
100 lbs. corn-and-cob meal	6.1
100 lbs. alfalfa meal	10.2
100 lbs. wheat bran	12.5
150 lbs. linseed oil meal	45.3
450 lbs. mixture	74.1

	Pounds protein
Mix. 18.— Protein, 16.71%.	
100 lbs. corn	7.1
100 lbs. oats	9.7
100 lbs. corn oil meal	16.5
125 lbs. linseed oil meal	37.75
425 lbs. mixture	71.05

LOW PROTEIN ROUGHAGE

PROTEIN IN GRAIN MIXTURES, 18 TO 22 PER CENT

	Pounds protein
Mix. 19.— Protein, 19.05%.	
100 lbs. corn	7.1
100 lbs. oats	9.7
100 lbs. wheat bran	12.5
250 lbs. linseed oil meal	75.5
550 lbs. mixture	104.8

	Pounds protein
Mix. 20.— Protein, 19.22%.	
100 lbs. barley	9.0
100 lbs. alfalfa meal	10.2
100 lbs. corn oil meal	16.5
200 lbs. linseed oil meal	60.4
500 lbs. mixture	96.1

	Pounds protein
Mix. 21.— Protein, 19.13%.	
100 lbs. corn-and-cob meal	6.1
100 lbs. oats	9.7
200 lbs. wheat bran	25.0
200 lbs. cottonseed meal	74.0
600 lbs. mixture	114.8

	Pounds protein
Mix. 22.— Protein, 19.28%.	
100 lbs. hominy feed	7.0
100 lbs. oats	9.7
200 lbs. wheat bran	25.0
200 lbs. cottonseed meal	74.0
600 lbs. mixture	115.7

	Pounds protein
Mix. 23.— Protein, 19.00%.	
100 lbs. corn	7.1
200 lbs. alfalfa meal	20.4
100 lbs. wheat bran	12.5
200 lbs. cottonseed meal	74.0
600 lbs. mixture	114.0

	Pounds protein
Mix. 24.— Protein, 19.21%.	
100 lbs. corn	7.1
100 lbs. oats	9.7
100 lbs. gluten feed	21.6
175 lbs. linseed oil meal	52.85
475 lbs. mixture	91.25

	Pounds protein
Mix. 25.— Protein, 18.98%.	
100 lbs. barley	9.0
100 lbs. oats	9.7
100 lbs. alfalfa meal	10.2
250 lbs. linseed oil meal	75.5
550 lbs. mixture	104.4

	Pounds protein
Mix. 26.— Protein, 19.21%.	
100 lbs. corn-and-cob meal	6.1
100 lbs. alfalfa meal	10.2
200 lbs. wheat bran	25.0
200 lbs. cottonseed meal	74.0
600 lbs. mixture	115.3

	Pounds protein
Mix. 27.— Protein, 19.28%.	
100 lbs. corn	7.1
100 lbs. oats	9.7
100 lbs. corn oil meal	16.5
225 lbs. linseed oil meal	67.95
525 lbs. mixture	101.25

The grain mixtures given are but samples. Other combinations may be made from the same feeds or with different feeds. The analysis of each concentrate is for the best grade. If the roughage is poor in quality, increase the protein in the grain mixture. Four grains are believed to give better results in mixtures than 3 grains, the cows being less likely to tire of the combination. The above system of balancing rations is not entirely accurate, but for ordinary practice it will give good results.

FEEDING HEAVY MILKING COWS

The larger the production of milk and butterfat, the more the skill required to feed a dairy cow efficiently, sufficiently, and economically. Lack of proper feed or unskillful feeding undoubtedly limits the production of many good cows. The first requisite of good feeding is to know how much the cow is producing in milk and butterfat. This necessitates the weighing of the milk at each milking and a monthly test for butterfat. The butterfat test may not always be convenient but every owner can at least weigh the milk.

Feed is the raw material from which the cow makes milk and maintains her body functions. The indications that a cow's body is functioning properly are a good appetite, a clear bright eye, a moist muzzle, normal temperature, soft skin and hair, and an even body weight or a slight gain as lactation advances. It is not necessary to take a cow's temperature unless she refuses her feed or shows other indications of ill health. Constant observation by the feeder will enable him to tell how a cow is feeling by her appetite. Then he has her milk flow to guide him; and if it is convenient to weigh the animal occasionally, a further check is furnished on the feeding. In feeding cows of large production it is necessary to keep a close check on everything in order to feed economically. Hay is always given in ample quantities and the appetite of the cow should always be the limiting factor. Silage should be fed in quantities of 2½ to 3½ times the hay. With such quantities of roughage, the grain is fed in quantities of about 1 pound for 3 to 4 pounds of milk produced or 7 pounds of grain for each pound of butterfat produced. After freshening, the high-producing cow cannot be given enough feed to meet her needs and she draws upon her reserve supply for a time. This should not continue for longer than 3 months. Watch the cow's weight, and after 3 months from freshening, a cow should gain slightly each month, especially after breeding.

Roots chopped fine are very useful for feeding to a high-producing cow since they allow the animal to consume large quantities of feed without digestive troubles. When available, dried beet pulp mixed with the grain and the whole allowed to soak with molasses water is very satisfactory.

FEEDING DRY COWS

Usually little attention is given to the feeding of dry cows before freshening. In the interval between drying up and the next freshening, at least 4 to 6 weeks should elapse. During this period the cow is able to build up a reserve supply of energy in the form of fat or as glycogen in the liver, provided she is fed liberally. If starved or half-starved, the milk yield the following lactation will be lessened. The reason many cows do not regularly produce to their maximum year after year, barring accidents, is that there has been a lack of the right kind of feed and the cow has to rebuild her reserve. Dry cows just before freshening should weigh from 100 to 250 pounds more than their average weight at the middle of a lactation. It must be remembered that little feed when dry means less milk when fresh.

WATER

Plenty of fresh water is essential for the health of a dairy cow. Large milk production requires much water, for it must be remembered that between six-sevenths and seven-eighths of the milk is water. Only clean water should be available for drinking, since foul, stagnant water may become the source of disease. During cold weather it is advisable to warm the drinking water with a tank heater to take off the chill. This is economical because a cow will not drink as she should if the water is very cold and may thus limit her milk production. Very cold water must be warmed by feed in her stomach. This is much more expensive than warming it by fuel. For best results, drinking water for cows should never be at a temperature lower than 10° above freezing.

SALT

A dairy cow requires from 1 to 2 ounces of salt daily. If rock salt or salt blocks are used, it is advisable to add 1 per cent of salt to the grain mixture, otherwise certain cows will not get enough salt because their tongues may become sore

from licking the hard blocks of salt. A good practice is to have boxes where coarse loose salt is available in addition to the block or rock salt.

ACCURATE BALANCING OF RATIONS

MORRISON FEEDING STANDARD

For the more accurate balancing of rations, either for individual cows or for the herd, the total nutrients as well as the digestible protein should be included. If the average is used when balancing for the herd, it will prove quite satisfactory.

DAILY REQUIREMENT FOR DAIRY COWS

	Digestible crude protein *Pounds*	Total digestible nutrients *Pounds*
Maintenance 1,000-lb. cow	0.700	7.925
Maintenance 100 lbs. of live weight	0.070	0.7925
For each 1 lb. of 3.0% milk	0.052 [1]	0.271 [1]
For each 1 lb. of 3.5% milk	0.055 [1]	0.300 [1]
For each 1 lb. of 4.0% milk	0.059 [1]	0.328 [1]
For each 1 lb. of 4.5% milk	0.063 [1]	0.357 [1]
For each 1 lb. of 5.0% milk	0.066 [1]	0.382 [1]
For each 1 lb. of 5.5% milk	0.070 [1]	0.406 [1]
For each 1 lb. of 6.0% milk	0.074 [1]	0.431 [1]

[1] Average of extremes.

To balance a ration, determine first the weight of the individual cow or the average of the herd. Then calculate the digestible protein and digestible total nutrients needed for maintenance for an animal of that weight. Next calculate from the milk yield the requirements of protein and total nutrients needed for the milk production. Add the protein required for milk production to the protein needed for maintenance and the total represents the daily requirement. Add in the same way the total nutrients needed for maintenance and for milk production and the total is the daily requirement.

For example, given a 1,200-pound cow producing 35 pounds of 4 per cent milk, with mixed clover and timothy hay, corn silage, corn, oats, bran, and oil meal available. Consulting the figures, the daily requirements are:

	Digestible crude protein *Pounds*		Digestible total nutrients *Pounds*	
1,200-lb. cow maintenance	0.840		9.510	
35 lbs. 4% milk	2.065		11.480	
Total requirement		2.905		20.990
40 lbs. corn silage	.440		7.080	
12 lbs. clover and timothy hay	.480		5.544	
Total nutrients supplied by roughage		.920		12.624
Nutrients to be supplied by grain		1.985		8.370
11 lbs. of Mixture No. 10		1.823		7.816
Nutrients lacking		.162		.554
1 lb. of Mixture No. 10		.165		.710
Excess nutrients		.003		.156

Usually it is easiest to make up a grain mixture with the same ratio between protein and total nutrients that exists after the nutrients in the roughage have been subtracted from the requirements.

TABLE 3.—*Analyses and Characteristics of Feeds*

	Digestible protein per cent	Carbohydrates + (2.25 x fats) per cent	Total nutrients per cent	Nutritive ratio	Bulk	Palatability	Physiological effect	Calcium or lime (CaO) in 1000 lbs.	Phosphoric acid (P_2O_5) in 1000 lbs.	Coefficients for getting the cost of protein and total nutrients in feeds. Multiply coefficient by cost per 100 lbs. of feed	
										Protein	Total nutrients
GRAINS AND CONCENTRATES											
Barley (ground)	9.0	70.4	79.4	7.8	Medium	Good	Neutral	x	8.5	11.11	1.259
Beet pulp (dried)	4.6	67.0	71.6	14.6	Bulky	Good	Slightly laxative	9.2	2.4	21.74	1.396
Corn meal	7.1	74.6	81.7	10.4	Medium	Good	Neutral	0.2	6.9	14.08	1.224
Corn and cob meal	6.1	72.0	78.1	11.8	Bulky	Good	Neutral	x	5.8	16.39	1.280
Corn bran	5.8	67.3	73.1	11.6	Bulky	Good	.....	x	6.2	17.24	1.368
Hominy feed	7.0	67.6	84.6	11.1	Medium	Good	Neutral	x	12.4	14.29	1.182
Kafir grain	9.0	71.0	80.0	7.9	Medium	Fair	Slightly constipating	x	5.7	11.11	1.250
Milo grain	8.7	71.2	79.9	8.2	Medium	Fair	Slightly constipating	x	7.8	11.49	1.252
Molasses (beet)	2.9	55.8	58.7	19.2	.....	Good	Very laxative	x	0.5	34.48	1.703
Molasses (cane)	1.0	58.5	59.5	58.5	.....	Good	Laxative	x	2.4	100.00	1.681
Oats (ground)	9.7	60.7	70.4	6.3	Bulky	Good	Slightly laxative	1.4	8.1	10.31	1.424
Rice (polished)	8.0	72.1	82.1	9.3	Bulky	Good	Neutral	0.4	30.8	12.50	1.218
Rye (ground)	9.9	71.1	81.0	7.2	Medium	Fair	Produces hard butter	x	7.3	10.10	1.234
Sorghum grain	7.5	72.0	79.5	9.6	Medium	Poor	Tends to dry up cows—constipating	0.2	8.2	13.33	1.258
Alfalfa meal	10.2	40.5	50.7	4.0	Bulky	Good	Neutral	19.5	5.4	9.80	1.972
Bran (wheat)	12.5	48.4	60.9	3.9	Bulky	Good	Slightly laxative	0.9	29.5	8.00	1.642
Corn oil cake meal (germ)	16.5	66.0	82.5	4.0	Medium	Good	Neutral	.....	13.2	6.06	1.212
Middlings (wheat)	13.4	55.9	69.3	4.2	Compact	Good	Neutral	0.8	21.1	7.46	1.443
Cocoanut meal (old process)	18.6	60.2	78.8	3.2	Medium	Fair	Laxative	x	12.4	5.32	1.269
Cottonseed meal (choice)	37.0	41.2	78.2	1.1	Heavy	Fair	Constipating	3.6	26.7	2.70	1.278

Analyses from "Feeds and Feeding," Henry and Morrison, eighteenth edition.

TABLE 3.—*Analyses and Characteristics of Feeds*—Continued

	Digestible protein per cent	Carbohydrates + (2.25 x fats) per cent	Total nutrients per cent	Nutritive ratio	Bulk	Palatability	Physiological effect	Calcium or lime (CaO) in 1000 lbs.	Phosphoric acid (P_2O_5) in 1000 lbs.	Coefficients for getting the cost of protein and total nutrients in feeds. Multiply coefficient by cost per 100 lbs. of feed	
										Protein	Total nutrients
Distillers corn grains (dry)	22.4	66.5	88.9	3.0	Bulky	Fair	Slightly laxative	0.6	6.8	4.46	1.124
Gluten feed	21.6	59.1	80.7	2.7	Medium	Fair	Neutral	3.5	6.2	4.63	1.238
Gluten meal	30.2	53.8	84.0	1.8	Heavy	Fair	Neutral	x	5.5	3.31	1.190
Linseed oil meal (new process)	31.7	44.2	75.9	1.4	Heavy	Good	Laxative	x	x	3.15	1.317
Linseed oil meal (old process)	30.2	47.7	77.9	1.6	Heavy	Good	Laxative	5.1	17.0	3.31	1.284
Malt sprouts	20.3	50.3	70.6	2.5	Bulky	Poor	Slightly laxative	2.1	16.5	4.93	1.416
Soy beans (ground)	33.2	60.9	94.1	1.8	Medium	Fair	Produce soft butter	x	13.7	3.01	1.061
Soy bean oil meal	39.7	44.8	84.5	1.1	Heavy	Good	Produces soft butter	x	x	2.51	1.183
DRIED ROUGHAGE											
Alfalfa hay	10.6	41.0	51.6	3.9	Bulky	Good	Slightly laxative	19.5	5.4	9.43	1.938
Clover hay (red)	7.6	43.3	50.9	5.7	Bulky	Good	Neutral to slightly constipating	16.0	3.9	13.16	1.964
Clover and timothy hay	4.0	44.2	46.2	10.6	Bulky	Good	Neutral to slightly constipating	x	4.7	25.00	2.164
Clover (sweet) hay	10.0	37.0	47.0	3.7	Bulky	Fair	Neutral to slightly constipating	x	x	10.00	2.149
Corn stover (medium in water)	2.1	44.0	46.1	21.0	Bulky	Fair	Constipating	6.6	4.0	47.86	2.164
Millet hay	5.0	50.0	55.0	10.0	Bulky	Good	Neutral to slightly constipating	x	3.6	20.00	1.818
Oat and pea hay	8.3	40.5	48.8	4.9	Bulky	Fair	Neutral to slightly constipating	x	6.6	12.05	2.049
Prairie hay	4.0	43.9	47.9	11.0	Bulky	Good	Neutral to slightly constipating	....	....	25.00	2.089

Analyses from "Feeds and Feeding," Henry and Morrison, eighteenth edition.

TABLE 3.—*Analyses and Characteristics of Feeds*—Concluded

	Digestible protein per cent	Carbohydrates + (2.25 x fats) per cent	Total nutrients per cent	Nutritive ratio	Bulk	Palatability	Physiological effect	Calcium or lime (CaO) in 1000 lbs.	Phosphoric acid (P_2O_5) in 1000 lbs.	Coefficients for getting the cost of protein and total nutrients in feeds. Multiply coefficient by cost per 100 lbs. of feed	
										Protein	Total nutrients
Sorghum hay	2.8	49.3	52.1	17.6	Bulky	Fair	Neutral to slightly constipating	3.9	....	32.14	1.919
Soy bean hay	11.7	41.9	53.6	3.6	Bulky	Good	Neutral to slightly constipating	17.2	6.8	8.55	1.365
Sudan hay	3.7	47.7	51.4	12.9	Bulky	Fair	Neutral to slightly constipating	x	....	27.00	1.945
Straw—oat	1.0	44.6	45.6	44.6	Bulky	Fair	Constipating	x	2.1	100.00	2.193
Straw—wheat	0.7	36.2	36.9	51.7	Bulky	Poor	Constipating	2.9	1.3	142.86	2.172
Timothy hay	3.0	45.5	48.5	15.2	Bulky	Good	Slightly constipating	2.5	3.1	33.33	2.061
SILAGE											
Corn silage (well matured)	1.1	16.6	17.7	15.1	Bulky	Good	Laxative	x	1.6	90.00	5.649
Corn silage (immature)	1.0	12.3	13.3	12.3	Bulky	Good	Laxative	x	1.2	100.00	7.518
Sorghum silage	0.6	12.7	13.3	21.2	Bulky	Good	Laxative	x	1.5	166.66	7.518
Sugar beet top silage	1.4	8.0	9.4	5.7	Bulky	Fair	Laxative	x	....	.....	10.638
Sugar beet pulp silage	0.8	7.2	8.0	9.0	Bulky	Good	Laxative	x	....	125.00	12.500
ROOTS—TUBERS											
Beets—common	0.9	9.3	10.2	10.3	Bulky	Good	Laxative	x	1.0	111.11	9.803
Beets—sugar	1.2	12.8	14.0	10.7	Bulky	Good	Laxative	x	0.8	83.33	7.142
Mangels	0.8	6.6	7.4	8.2	Bulky	Good	Laxative	0.2	0.4	125.00	13.513
Potatoes	1.1	16.0	17.1	14.5	Bulky	Good	Laxative	x	1.2	90.90	5.848

Analyses from "Feeds and Feeding," Henry and Morrison, eighteenth edition.