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UNIVERSITY OF MINNESOTA
AGRICULTURAL EXPERIMENT STATION

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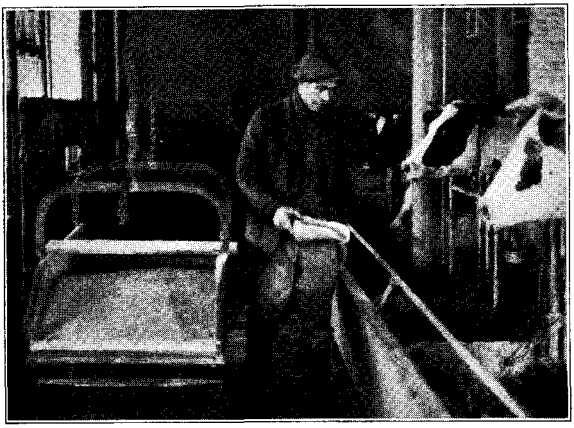


UNIVERSITY FARM, ST. PAUL

FEEDING THE DAIRY HERD

C. H. ECKLES AND O. G. SCHAEFER

INTRODUCTION

The amount of milk and butterfat produced by a dairy herd depends upon two things: The first is the efficiency of the cows used, their natural capacity for producing milk. Natural capacity to give milk is born in a cow; it can not be put into her by feed and care. To get a herd of cows that are efficient milk producers requires (1) good breeding, and (2) a constant culling out of the unsatisfactory individuals. The second factor controlling milk production is feed and care. Proper attention to the selection of the individual and to good breeding insures animals that have the capacity to produce milk liberally when properly fed. Given the right kind of animals, the amount of product secured will depend upon how skillfully they are fed and cared for. The inherited ability of the cow to produce milk and the skill with which she is fed and managed, contribute about equally to the final result.

The average Minnesota cow produces not more than 160 pounds of fat a year. This average, entirely too low, results from lack of inherited ability to produce freely, on the one hand, and from too poor feeding, on the other. Even the cows now in use could readily average at least 200 pounds of fat if they were fed properly. An experiment by the Minnesota Experiment Station shows that this statement is conservative. Four cows were recently purchased from a Minnesota farmer. These cows had averaged 182 pounds of fat for two years. The following year they were fed with a suitable ration, entirely home-grown, and produced an average of 259 pounds of fat, an increase of 77 pounds of fat each for the year. The added cost of feed was $11.96 for each cow. There was an increase in income, above cost of feed, of $25 an animal. It is not too much to say, then, that by feeding intelligently and by culling out some of the poorest cows, the average production of the cows of this state could within one year easily be raised to 258 pounds, which is the average of all cows in test associations in the state.

SUMMER CONDITIONS THROUGHOUT YEAR

Every dairy farmer knows that under ordinary farm conditions it is easy to get a satisfactory milk production during early summer when pastures are at their best. This suggests that in order to get good results the rest of the year the conditions of early summer should be maintained. This is exactly what the good dairyman does. The conditions of early summer which make possible maximum production are:

1 An abundance of feed
2. Palatable feed
3. A succulent ration
4. A sufficient amount of protein
5. Moderate temperatures and comfortable surroundings.

1. **An abundance of feed.**—One of the most common mistakes made in winter feeding is failure to provide enough feed. The cow may be looked upon as a milk factory, and as in any other manufacturing plant, the cheapest production is possible only when the plant is run nearly to full capacity. A dairy cow producing 250 pounds of fat yearly has to use about half a full ration to maintain her body. The same amount of feed is required for body maintenance whether a cow is producing to full capacity or is giving no milk at all. The other half of the ration is used for producing milk. The most common mistake in feeding dairy cows is the failure to give enough feed to make full use of the milk-producing ability of the animal. It should be clear that after giving a cow the first half of a full ration necessary to keep her alive, and after giving her barn room, running the risk of her dying, and doing chores for her the year round, it is the poorest possible economy not to give her the second half of a full ration, which she will use in producing milk.

This does not mean that all cows should be given heavy rations of grain or that cows can not be over-fed. It means that the cheapest milk production is possible when the cow is fed all she will use for producing milk. It also means that cows must be fed as individuals, that is, in proportion to their milk production. The fresh cow milking liberally is the one most often underfed. No farmer can afford to keep a herd of half-fed cows.

2. **Palatable feed.**—A cow will do her best when she relishes her feed. A ration so prepared as to give every-

thing a cow needs might fail to enable her to do well because she would not eat enough of it. The greatest variation in palatability is with roughages. For example, a chemical analysis shows little difference between hay cut at the proper stage and hay cut when too mature. The real feeding value, however, is quite different on account of a loss of palatablity. One reason why cows drop so rapidly in milk production in midsummer is that the grass is not so palatable as earlier in the summer.

3. **A succulent ration.**—The second reason why cows do especially well on pasture is the succulent character of the feed. Succulent feeds—roots, silage, and grass—contain the original juices, in contrast with feeds which are dry, as hay. A succulent feed, in addition to its actual food material, keeps the digestive system in good order. In the corn belt, corn silage furnishes succulent feed in the cheapest form. In regions too far north for corn, the sunflower is coming into use. Roots, especially mangels, are recommended for use in northern latitudes or when a herd is too small to justify the building of a silo.

4. **A sufficient amount of protein.**—Next to the failure to feed liberally enough is the failure to give enough protein. Fresh pasture grass supplies sufficient protein, but the winter ration, especially if corn and timothy or wild hay are fed liberally, is too often lacking in protein. If a cow; having enough other material to produce 30 pounds of milk, gives only 15 pounds on account of a shortage of protein, it is useless to increase the ration further. The thing to do is to change the ration by the addition of a small amount of concentrate high in protein. The practical feeder should become familiar with the composition of the ordinary feeds and use his knowledge as a basis of selecting a ration. Suitable rations are found on a later page and information is also given as to the methods of calculating rations according to the composition of feeds.

SUMMER FEEDING

A dairy herd should not be turned on pasture until the grass is well started. Grass can grow only by having leaves in the sun, and if it is eaten off close from early spring the grazing will be poor all summer. Give the grass a good start.

Fresh grass has more than 80 pounds of water to each hundred pounds. When turning the cows on pasture it is wise to continue feeding some silage or grain, if they will take it, at least during the first two weeks. While the pasture is at its best the cow has the best possible roughage, and the only question is that of feeding concentrates.

Economy of feeding grain on pasture depends upon the amount of milk the cow is giving. A small milk producer will not pay for grain while on good pasture, but it is a serious mistake not to feed some grain to a heavily producing cow. A production of a pound of fat a day or more justifies some grain. Experiments show that the returns from grain feeding do not all come at the time the grain is fed. Cows receiving grain in summer will milk better the following winter.

The following figures from cow test associations in Minnesota show that feeding grain in summer pays.

	Pasture only	Pasture with grain
Number of cows	1231	572
Average fat yield, pounds	228	296
Average feed cost, year	$41.87	$49.33

In these herds $7.46 spent for additional grains during the pasturing season gave a return of 68 pounds of fat worth $27.50 at 40 cents a pound.

The following are suggested as suitable amounts of grain to feed while cows are on pasture:

Guernsey or Jersey producing:	
Pounds milk daily	Should have Pounds grain daily
20	3
25	4
30	5½
40	8

Holstein, Brown Swiss, Ayrshire, or Shorthorn producing:	
Pounds milk daily	Pounds grain daily
25	3
30	4
35	5½
40	7
50	9

For higher production, feed about one pound to each 4 or 5 pounds of milk produced.

It should be kept in mind that these recommendations apply only when pastures are good. If pastures are short, as is often the case in late summer, some roughage, such

as silage, hay, or soiling crops, is also needed. When the amount of grain fed is small any farm grains, such as corn, barley, or oats, serve the purpose. The grass supplies a liberal amount of protein.

When liberal grain feeding is necessary—for example, 6 pounds or more daily—attention must be given to increasing the protein. For a very heavily milking cow receiving a large grain ration, the same mixture as used for winter feeding would be suitable.

Providing for periods of short pastures.—The statements as to feeding grain on pasture apply only when pasture is abundant. Unfortunately the season of abundant pasture is often short. Probably as much loss occurs from poor feeding conditions during the dry hot spell common in midsummer as from improper feeding during the winter. If the milk flow drops from lack of feed during the summer, it is impossible to bring it back fully later, even with the best of feeds. Poor milk production in winter is often the result of poor summer conditions.

Provision should be made to have a succulent feed ready for summer feeding if needed. The choice will usually lie between silage and soiling crops. Alfalfa and late summer corn cut green make an excellent supplement to the pastures. A series of crops that will furnish green feed throughout the summer can be planned.

The summer silo.—The best plan for the majority is to use silage to help out the poor pasture. In order that silage may be fed in summer without serious loss, the silo should have a small diameter so that a deeper layer will be fed daily; a silo 12 feet in diameter is ample for 30 cows. If the silage in reserve for summer feeding is not needed it may be used in winter or will keep over for another summer.

FEEDING PRACTICE

Grinding grain.—Grinding increases the digestibility of feeds only if the animal would not thoroly chew the unground kernels. A cow receiving a liberal grain ration fails as a rule properly to masticate whole grains, as oats and corn. Experiments have shown a loss of from 12 to 20 per cent in feeding unground grains. This fully justifies

the common practice of feeding ground feed almost exclusively. With young animals the loss is less, with calves as low as 2 per cent. When no hogs are on hand to gather up the grain otherwise wasted, it would ordinarily be economical to spend in grinding a sum equal to 10 per cent of the cost of the grain fed.

Variety.—If an animal in good health loses its appetite for feed, the ration usually lacks variety. If there is enough variety in the roughage and grain fed, animals may be continued on the same ration for long periods without loss of appetite. When several concentrates are included in the grain mixture, there is less danger of a lack of any certain kind of protein or mineral matter than when a smaller number is used. For winter feeding, two kinds of roughage are desirable—one a succulent feed and the other preferably a legume hay. For ordinary farm conditions a mixture of three grains or by-products in the concentrates fed is advisable, for example, corn, oats, and barley; or corn, bran, and linseed meal.

For heavily producing cows a greater variety is needed. Five different feeds in the mixture are better than three, and under conditions of official testing as many as seven are often used. A mixture which represents different plants is better than a mixture mostly from one. For example, a ration of corn silage, corn stover for roughage, and corn gluten feed, and oats would represent only two plants; while a ration of corn silage, alfalfa hay, corn, oats, bran, and barley would represent five plants and would for this reason be decidedly better.

Order of feeding.—Cows are creatures of habit, and it is important to follow regularly the same order of feeding and milking, and at the same hour each day. As a rule, cows are fed as often as they are milked. When cows are milked three or four times, as on official test, grain is usually fed at the same time. When the grain is fed twice a day, hay is often fed between grain feedings. The grain is usually fed first, just before milking. If the grain is fed in a manger containing roughage, the cows will often throw out the rough feed to get the grain. Hay and silage are usually fed following milking. Both may be fed at each feeding, or hay at one feeding and silage at the other.

Feeding the fresh cow.—After calving, the heavily milking cow, especially, should be brought to full feed carefully. During the first two or three days the grain fed should be light and laxative in character. A mixture of oats, bran, and linseed meal meets the requirements. After this the cow may receive the regular ration, the amount to be increased as her physical condition permits. If the udder is congested, the amount of grain must be kept low until the inflammation subsides. Sometimes a heavily milking cow can not be put on full feed before 30 days. A heavily producing cow loses some weight during the first month, but from this point for about six months her weight should remain about constant. As the end of her milking period approaches, it is proper for her to begin to gain in weight.

Amount of grain to feed.—Grain should be fed in proportion to the amount of milk produced. A fresh cow in good flesh will milk liberally for a time even if the feed is deficient by taking nutrients from her body for the purpose. A heavily milking cow is usually underfed for a time and as a rule loses some weight. As soon as safe, the grain mixture should be increased until the animal is receiving a sufficient amount to supply what is needed for the milk she is producing and the decline in weight is checked.

If a cow gives 40 pounds of milk a day, care must be taken that she has feed enough for this amount or she will soon fall off greatly. With the fresh cow it is often difficult to judge when the maximum amount of grain she will use to advantage is reached. If, for example, a cow is producing 35 pounds of milk daily and is receiving 11 pounds of grain, the feeder may be uncertain whether she would go any higher by more liberal feeding. In this case the proper plan is to increase the feed slowly to possibly 15 pounds daily and watch the milk sheet If the milk increases it shows more feed was needed and should be continued. If no increase results in two or three days, the feed should be reduced to 11 pounds, as it is evident that she will not respond to further increases. When a cow already receiving an ample ration declines in milk as, for example, after having been in milk for several months, she can not be brought back by increasing the feed. The

thing to do in this case is to reduce the ration in proportion to the drop in milk production. The amount of grain fed should always be adjusted to the needs of the individual animals.

The most accurate means of estimating the feed requirement of the cow is by the use of the feeding standard, which is explained on a later page. For those who do not care to make these calculations, the rules which follow are suggested as reasonably safe guides.

RULES FOR FEEDING

1. Feed all the roughage a cow will eat. This should include a succulent feed and a legume hay.

2. With a good roughage—as alfalfa, soybean, or clover hay—feed a Jersey or Guernsey one pound of grain to each 2½ to 3 pounds of milk; a Holstein, Ayrshire, Brown Swiss, or Shorthorn, one pound of grain for each 3 to 3½ pounds of milk.

3. With a poor roughage such as timothy or wild hay, feed a Jersey or Guernsey one pound of grain for each 2 pounds of milk; a Holstein, Ayrshire, Brown Swiss, or Shorthorn, one pound of grain for each 2½ to 3 pounds of milk.

WINTER FEEDING

As previously indicated, successful winter feeding means imitating the conditions of early summer. Adapted by nature to the use of bulky feeds, the dairy cow does not feel satisfied and does not give the best results unless she receives a liberal supply of a good quality of hay with some succulent feed. The better the hay and succulent feeds, the larger the proportion of nutrients received from this source, and the smaller the amount of grain required, With poor roughages the grain mixture must necessarily be more complex and must be supplied in larger amounts.

A good ration must furnish protein and total digestible nutrients sufficient to maintain the cow and to supply the material necessary for the milk she is producing. In addition, the ration must be relished by the animal and contain some feeds that are of a laxative nature to keep the cow in good physical condition. Last, but not least, desirable qualities in feeds must be furnished economically.

The feeder who wishes to select the ration to the best possible advantage will become familiar with the composition of feeds and the method of calculating a ration as shown later in this publication. However, for those who do not wish to proceed in this way, sample grain mixtures are given in the paragraphs which follow. In Minnesota most farmers make use of one or more of a limited number of standard roughages. The nature of the roughage to a great extent determines the character of the grain mixture which should be fed.

Any of the grain mixtures when fed with the roughages indicated, will make balanced rations for cows producing up to a pound of fat per day. For cows producing a pound or more per day, an additional amount of high protein feed should be added to the suggested rations.

As will be noted, the use of alfalfa, clover, or other legume hay will greatly decrease the cost of the grain mixture. Silage or other succulence is desirable in all rations. If no succulence is furnished, the same grain mixture can be fed in somewhat larger amounts, but the results will be less satisfactory. It is assumed in all cases that the cow will be given what roughage she will eat up clean. The amount of the grain mixture to be fed is shown by the rules for feeding on page 10.

Group I

When the roughage consists of corn silage or roots and a legume hay such as alfalfa, clover, or soybean hay, feed one of the following mixtures at the rate shown on page 10.

(1)	Lbs.
Ground oats	200
Ground corn	100
Ground barley	100

(2)	Lbs.
Ground barley	200
Ground oats	100
Gluten feed	100

(3)	Lbs.
Ground barley	200
Ground oats	100
Wheat bran	100

(4)	Lbs.
Ground oats	300
Ground corn	200
Ground wheat	100

(5)	Lbs.
Ground corn	200
Ground oats	100
Wheat bran	100

(6)	Lbs.
Ground oats	400
Ground corn	300
Ground rye	100

Note 1: For cows producing more than one pound of fat daily, add one pound of linseed meal.

Note 2: When silage is not available, feed the same grain mixture but in somewhat larger amounts.

Group II

When the roughage consists of corn silage, and mixed hay one half of which is leguminous and the other half timothy or wild hay, feed one of the following mixtures at the rate shown on page 10.

(1)	Lbs.
Ground oats	300
Linseed meal	150
Ground barley	100
Ground corn	100

(2)	Lbs.
Ground oats	200
Ground wheat	150
Wheat bran	100
Linseed meal	100

(3)	Lbs.
Ground oats	200
Ground barley	200
Wheat bran	100
Linseed meal	100

(4)	Lbs.
Ground oats	400
Ground barley	300
Linseed meal	200

(5)	Lbs.
Ground corn	200
Ground oats	200
Wheat bran	200
Cottonseed meal	100

(6)	Lbs.
Wheat bran	100
Ground barley	100
Gluten feed	100

Note: When silage is not available, feed the same grain mixture but in somewhat larger amounts.

Group III

When the roughage consists of corn silage and timothy hay, wild hay, or corn stover, feed one of the following mixtures at the rate shown on page 10.

(1)	Lbs.
Ground barley	100
Ground oats	100
Wheat bran	100
Linseed meal	100

(2)	Lbs.
Ground oats	300
Wheat bran	300
Cottonseed meal	200
Ground barley	150

(3)	Lbs.
Ground corn	100
Ground oats	100
Wheat bran	100
Cottonseed meal	100

(4)	Lbs.
Ground barley	400
Wheat bran	300
Linseed meal	300

(5)	Lbs.
Ground oats	300
Linseed meal	200
Ground corn	100
Ground barley	100

(6)	Lbs.
Ground oats	250
Ground barley	250
Linseed meal	200

Note: When silage is not available, feed the same grain mixture but in somewhat larger amounts.

ROUGHAGES FOR DAIRY COWS

Legume Hays

Alfalfa.—Properly cured alfalfa hay easily ranks first among hays for dairy cattle. It is very palatable and is laxative in character. It is high in protein, containing more than three times as much as timothy, and is the highest of all common feeds in calcium. Almost any ration not containing alfalfa is improved by its addition.

Clovers.—Clover hay, either red or alsike, has the same advantage as alfalfa. However, it is not quite so palatable and is a little lower in protein. Alsike has practically the same composition as red clover, but is finer stemmed, making it especially well adapted for calf feed.

Sweet clover.—Properly cured hay from this legume has a feeding value only a little below that of red clover, altho a considerably larger proportion is usually refused. Sweet clover should be thickly sown so that the stems will not grow too coarse. The crop should be cut when the first blossoms appear as the stems rapidly grow woody after this stage is reached. Care must be taken in curing, otherwise the leaves become brittle and shatter badly. The most common practice followed is to cut with a binder and cure in shocks.

Soybean hay.—This hay is slightly behind alfalfa as a feed for dairy cows, but has the same advantages.

Oat and pea hay.—This mixture is grown for hay to a considerable extent in northern latitudes. If cut at an early stage it is palatable and nutritious. The protein content is about three-fourths that of alfalfa, while the total digestible nutrients are about equal.

Non-Legume Hays

Timothy hay.—This hay is widely grown because timothy does well everywhere and is easy to start. As a feed for dairy cows it is usually over-estimated. It is not palatable except when cut early. The low protein content is the most serious objection. When timothy is used as roughage it is almost impossible to avoid the use of large quantities of expensive purchased protein feeds. It is the lowest in minerals of all common feeds.

Prairie hay.—Wild or prairie hay is used extensively in Minnesota. In feed value the better grades rank a little above timothy while a poor, coarse quality ranks below timothy. Like timothy it is very low in both protein and mineral matter and only the better grades can be termed palatable.

Millet hay.—This roughage also ranks with timothy in feeding value but is less palatable. It is not a desirable hay for dairy cows. It should be cut when in blossom in order to produce the most palatable hay.

Fodders

Corn fodder.—The term "corn fodder" as commonly used means corn cut just before maturity and shocked in the field, and includes the ears. Corn fodder is often used for wintering beef cattle, especially if hogs are kept to gather up the corn otherwise wasted. Corn fodder is not very satisfactory for dairy cows kept mostly in the barn. There are difficulties in feeding it in the manger, and when used it is generally fed outdoors. It is low in protein and relatively unpalatable. Aside from the grain included, it is about equal to timothy hay in total nutrients.

Corn stover.—Corn stover is corn fodder from which the ears have been removed. It is very low in protein and is unpalatable. It may be used to a limited extent as a roughage for dairy cows. Its feeding value is not far from that of timothy hay, and is not increased by shredding. It makes the storage and handling of the fodder easier, and the refuse can be used to advantage as bedding.

Sorghum fodder.—Sorghum is sometimes cut and cured in shocks. Sorghum is eaten fairy well for two months after cutting, but it sours and is decidedly unpalatable later in the winter. The feeding value is about the same as that of corn stover.

Straws

Oat straw.—Dairy cows will eat a limited amount of oat straw from grain cut rather early. It should not be depended upon for any considerable part of the ration. Cows turned outdoors during the winter will eat a little straw if fed in the open. It is very low in protein and in total nutrients, and is unpalatable. In a well fed dairy herd its only important use is for bedding.

Wheat straw.—Wheat straw is hardly to be counted as a feed, but is excellent bedding material.

Rye straw.—Rye straw is useful only as bedding. It is so unpalatable that cattle will hardly eat it, and the digestible nutrients are so low that it would be practically useless if eaten.

Barley straw.—Cattle will eat barley straw to a limited extent. It is decidely low in feed value and there is some danger of the beards penetrating the sides of the mouth and causing trouble.

Silage

Corn silage.—Corn silage offers the best means of supplying the necessary succulence during the winter. Silage is not in itself a complete ration for a cow in milk, as it is low in protein. It has a high moisture content, averaging only 30 pounds of dry matter in 100. It is not advisable to feed silage as the only roughage. Some hay should be given in addition and for this purpose a legume is the best on account of the high protein and ash content. Thirty-five pounds of silage is a day's allowance for a small cow and 40 to 45 pounds for a large cow.

Sorghum silage.—Common sorghum yields heavily and makes satisfactory silage, ranking somewhat below corn. Care must be taken to allow the crop to reach the proper stage of maturity before putting it in the silo, otherwise the silage will be too acid.

Pea and oat silage.—These crops grown together make good silage if cut when the oats are beginning to turn yellow. The protein content is a little higher than that of corn and the total nutrients are about the same.

Sunflower silage.—Sunflowers grow in regions where the temperature is too low to develop corn to advantage. The yield is large and the silage of fair quality, ranking in feeding value about with silage made from corn cut at the proper stage of maturity. It is less palatable than corn silage, altho cows soon learn to eat it.

Legume silage.—A satisfactory silage may be made from alfalfa or clover if put in the silo in proper condition. As a rule, however, it is best to preserve the legumes in the form of hay unless bad weather prevents. The protein content of legume silage is higher than that of corn and the total amount of nutrients about the same. The important thing in making silage from legumes is to be sure that they do not contain too much water. If cut when in a very succulent condition the material should be allowed to dry partially before placing it in the silo.

Roots, Tubers, Pumpkins

Mangels.—The mangel is the most widely used root crop. Like all other root crops it has a large amount of water, averaging less than ten pounds of dry matter to

the hundred. The mangel is unexcelled in adding succulence to the ration: It is very palatable and should be fed more generally. Forty to sixty pounds a day is a fair allowance for a mature animal. Where there are too few animals to justify a silo, mangels are especially recommended.

Rutabagas.—These have the same advantage as mangels and practically the same feeding value. As with turnips, there is some danger of the milk being tainted when fed in large quantities. They do not yield as high as mangels, and for this reason are not so generally grown.

Sugar beets.—Sugar beets are not generally grown for feed as the yield is lower than of mangels and the labor of growing them is greater. They are, however, valuable feed, ranking somewhat above rutabagas and mangels. If beets are grown for market the tops should be preserved for feeding. This is best done by putting them in the silo. Beet tops have a feeding value about two-thirds that of corn silage.

Potatoes.—Cull potatoes are available at times in sufficient quantities to justify considering their use as feed. Potatoes contain about double the dry matter of roots but are not so desirable a feed for cattle. The feeding value of potatoes is close to that of silage, pound for pound. Potatoes may be fed up to 25 pounds daily. Larger amounts have a bad effect upon the quality of the butter and are also likely to cause indigestion in the animals. They are one of the few feeds that are better cooked.

Pumpkins.—Pumpkins provide an excellent supplement to the ration for a period in the fall. The feeding value is not high and they should be considered more as a relish than as a food. There is less than ten pounds of dry matter to the hundred. Two and a half tons, including seeds, are required to equal one ton of silage. The seeds are sometimes removed when pumpkins are fed, because of the erroneous idea that they are injurious to cows. The seeds are rich in nutrients and contain no injurious substances.

Concentrates

Corn.—Corn forms a part of the grain ration on most dairy farms. It is sometimes fed to excess. On the other

hand, some go to the other extreme and do not feed it, thinking it is not suited to a cow producing milk. It is especially palatable and a splendid feed for the cow in milk. The protein content is low, likewise the mineral matter. If fed with corn stover or corn silage the protein content is entirely too low. Corn silage and ground corn combined with clover or alfalfa and bran, however, make a good ration for general feeding.

Corn and cob meal.—When ear corn is ground the product is known as corn and cob meal. The cob is hard to grind and requires considerable power. Unless the cob is ground rather fine the animal will usually leave a considerable part uneaten. The only advantage of corn and cob meal over corn meal for dairy cows is that if the grain ration is lacking in bulk, the ground cob helps to supply it. The cob in itself is practically indigestible. As the grinding of the cob requires considerable power and the cob is of so little value to the animal, under usual conditions it is best to shell the corn before grinding.

Oats and oat products.—Oats are excellent feed for dairy cows and growing animals, having a feed value of about ten per cent more pound for pound than bran. Oats contain a liberal amount of protein but not enough to be effective in making up a deficiency in this constituent in the ration. The valuable by-products from oats are mostly from oatmeal factories and consist of oat shorts and fine parts of the grain. In addition, a large amount of hulls must be disposed of. The hulls are largely crude fiber and hardly equal to timothy hay in feed value. Sometimes oat hulls are used in cheap mixed feeds that are put on the market.

Barley.—Barley is a valuable feed for dairy cows. Corn, on account of its cheapness and abundance in the past, has largely taken the place of barley in the ration. Barley should be looked upon as practically equal to corn pound for pound. Its use as a feed for dairy cows is increasing.

Rye.—Rye has a composition not greatly different from corn, but ranks somewhat below it. It is rather unpalatable and if fed in large quantities tends to produce butter with a hard body. If mixed with other feeds it may be fed in amounts up to three pounds a day.

Linseed meal.—This valuable feed is the residue after linseed oil is extracted from flax seed. It ranks second only to cottonseed meal in digestible protein, altho on the market it generally sells a little higher. Linseed meal appears to have a specially favorable effect upon all kinds of animals to which it is fed. It is of special value as a means of supplying protein liable to be lacking in a farm-grown ration.

Cottonseed meal.—This feed stuff contains the highest amount of protein of any feed ordinarily fed to cattle, hence is especially valuable as a means of balancing a ration in which corn products form a large part. As a rule, two or three pounds a day are the maximum to be used. When it is desired to buy cottonseed meal in large quantities and to store it for some time, especially in the summer, it is best to buy it the form of broken cakes, which may be easily ground as needed.

Gluten meal.—This feed is a by-product of starch and glucose manufacture. It ranks high in digestible protein but is rather heavy and somewhat unpalatable and should always be fed in a mixture with other feeds of a more bulky nature. The protein content varies considerably and it is always best to buy on a guaranteed analysis.

Gluten feed.—Gluten feed is gluten meal with corn bran added. It is high in protein altho lower than gluten meal. In recent years it has been more widely used than gluten meal. Gluten feed is a valuable an dat times an economical source of protein. As with gluten meal, it is always well to buy it on the basis of a guaranteed analysis.

Wheat bran.—Wheat bran ranks next to corn in importance among the feeds used by the dairyman. Its value comes from the high protein and mineral content and from its light loose character, which makes it a valuable addition to a heavy ration by loosening the mass so it is more easily acted upon by the digestive juices. Bran is often expensive as a feed and by proper selection a mixture can be prepared without bran which will be satisfactory and at times economical.

Wheat middlings.—Wheat middlings or shorts are useful feeds but are more like corn in composition and properties than bran. As a rule it is wiser to use bran rather

than shorts for the cow in milk. If middlings can be purchased cheaper pound for pound than corn, it may be used as a substitute for corn in the ration.

Wheat screenings.—Screenings from wheat are available in large quantities in this state. This product consists mainly of broken and shrunken wheat kernels and a variety of weed seeds. More or less worthless trash may be included. High-grade screenings have a feeding value about ten per cent below that of oats. The quality varies widely and consequently this product should be purchased only on personal inspection or guaranteed analysis. Screenings have a rather bitter taste and are for this reason somewhat unpalatable. Cattle take them readily, however, when mixed with other ground feed. Farmers usually hesitate, and properly, in using screenings for fear of bringing obnoxious weeds on the farm. Thoro grinding of the screenings removes this danger. The main channel for the disposal of screenings is in commercial mixed feeds, usually with a variety of other ground concentrates and often with some molasses.

Dried beet pulp.—Beet pulp is the residue after the sugar has been extracted from sugar beets. Dried beet pulp is high in carbohydrates in proportion to protein, ranking in this respect below corn.

In feeding it should be combined with other feeds richer in protein. It swells when moistened and can not be pressed into a compact mass. For this reason it is easy to digest and valuable to lighten up a ration that otherwise would form in the stomach a mass not easily penetrated by the digestive juices. Dried beet pulp is especially useful in feeding cows for the maximum production, as under official testing conditions. Several hours before feeding, dried beet pulp is usually moistened with about three times its weight of water. The grain mixture is either mixed with it or spread over it in the feed box.

Molasses.—Black Strap molasses has about sixty-five per cent of the feeding value of corn. From the standpoint of total digestible nutrients, molasses is not as a rule, an economical feed in this state. It serves a useful purpose as a means of making unpalatable feeds more readily consumed. On account of its palatability it is sometimes used

to cover up inferior quality in a feed in order to disguise materials of little feeding value. Molasses is also useful as an appetizer for animals receiving a heavy ration, and is used with satisfaction by many feeders of cows on official test. It is also used extensively in commercial mixed feeds, adding palatability.

Mixed Commercial Feeds

No small proportion of the grain purchased by farmers for feeding dairy cows is in the form of ready mixed feeds. These mixtures have the advantage of supplying the necessary variety and save the labor of mixing. In the past commercial mixed feeds were not looked upon with favor by many because of the common practice by unscrupulous manufacturers of using this means of disposing of inferior products. However, feed control laws are now in operation which require the labeling of each sack with a guaranteed analysis, and in Minnesota, as in most other states, provision is made for an inspection by state authorities to insure the enforcement of the law. Many reliable companies are now engaged in the business of preparing mixed feeds. By patronizing these and giving attention to the guaranteed analysis, the buyer may often use this class of feeds with advantage.

Where all the grain is purchased, mixed feeds should be considered and the decision as to their use should depend largely upon the relative price. When feed is purchased in small quantities the advantage of variety which the mixed feeds offer is of importance.

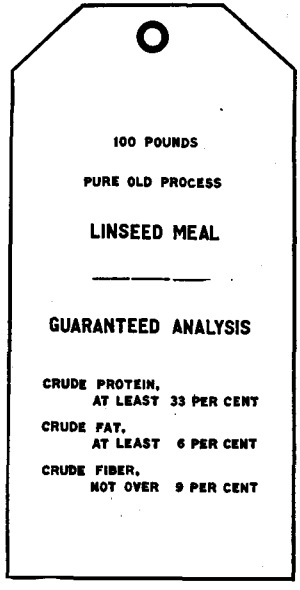
The farmer who grows most of his concentrates, as corn, oats, and barley, as is usual in Minnesota, and needs chiefly a high protein feed to balance his home-grown ration, should consider fully the relative merits of this class of feeds and the common high protein feeds, linseed meal, cottonseed meal, and gluten feed. Under these conditions protein is needed and as a rule the cheapest protein is to be had in feeds carrying a large percentage, such as linseed or cottonseed meals. The careful buyer will calculate the cost of a pound of protein from each before deciding upon his purchase.

Buying by Guaranteed Analysis

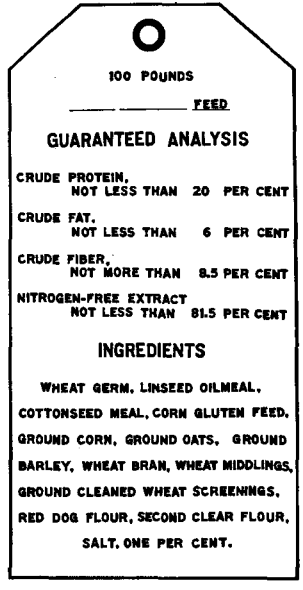
The Minnesota Feed Stuffs Control Law, like that of other states, does not guarantee the quality of the feed sold in the state. It does, however, require that information regarding the mixture be given which will make it possible for the buyer to know what he is getting. This is done by requiring that each sack be labeled with a statement of the guaranteed analysis and of the ingredients of the mixture. One of the specimen tags reproduced is from a sack of mixed feed; the other from a sack of linseed meal.

It should be clearly understood that the figures on the tags give the total amount of protein, fat, etc., as found by chemical analysis. The animal can use only a part of these; that is, the protein, for example, is not all digestible. The figures on the labels are therefore not the same as the digestible protein and total digestible nutrients as given in Tables 3 and 4, but are somewhat higher. The tag given for mixed feed shows 20 per cent crude protein. It is not fair to compare the protein content of this feed with that of gluten feed, for example, which is shown by the table of analysis to contain 21.3 per cent digestible protein. Just how much digestible protein or total nutrients the mixed feed contains can not be estimated accurately because the proportion of the ingredients is not given and the protein of different grains varies in digestibility. It would not be far wrong to estimate that 78 per cent of the protein is digestible and therefore used by the animal. That is, the feed contains about 15.6 per cent of digestible protein and is nearer to wheat bran in this constituent than to gluten feed.

The fat, crude fiber, and nitrogen-free extract are also given in the form of the crude and not the digestible product. Fat is high in food value, and is digestible to about the same extent as the protein. The crude fiber is the woody part of the plant, a good example of which is cornstalks, and a much smaller proportion of this class is digestible. While high protein, fat, and nitrogen-free extract percentages are desirable, on the other hand, high grade feeds have a low crude fiber content. The nitrogen-free extract is mainly starch and is known also as a carbohydrate.



Tag from Sack of Linseed Meal



Tag from Sack of Commercial Mixed Feed

In order to have a basis for comparing mixed feeds, the chemical analysis of a few common feeds is given below in the same form. By comparing the label on a feed sack with these figures it will be possible to learn which one of the common feeds the mixture most nearly approaches.

	Crude protein per cent	Crude fiber per cent	Crude fat per cent	Nitrogen-free extract per cent
Corn	9.4	1.9	4.8	67.6
Barley	11.5	4.6	2.1	69.8
Oats	12.4	10.9	4.4	59.6
Linseed meal	33.9	8.4	7.5	35.7
Gluten feed	25.4	7.1	3.8	52.9
Wheat bran	16.0	9.5	4.4	53.7

It will be noted that the mixed feed, according to the label, contains an unusually large variety of feeds, which is a distinct advantage. No information is given, however, as to the proportion of each, and the proportions of the more expensive feeds, as cottonseed and linseed meal, are undoubtedly small. Note also that wheat screenings are included. There is no special objection to this if thoroly ground to prevent germination of weed seeds.

The buyer of mixed feeds should make it a point fully to inform himself regarding these matters. It is wise to keep in touch with the experiment station and the official in charge of feed control (in Minnesota the Dairy and Food Commission) and obtain such advice and information as is provided by these agencies.

MINERAL REQUIREMENTS

Common salt.—The craving of livestock for common salt is not merely a taste for this substance, but is based upon a real need of the body. A dairy cow without access to salt develops a strong craving for it within a few days. If none is given she will gradually lose vitality, the hair will become rough, she will become thin in flesh, and finally will suffer a complete breakdown. A cow uses salt in proportion to the feed consumed. A heavily producing cow therefore needs more salt than a small milker or a dry cow.

The amount of salt needed is about three-fourths of an ounce daily for a 1000-pound cow and one-half ounce in addition for each 20 pounds of milk.

The most common plan for supplying salt is merely to keep it before the animals, allowing them to use what their appetite calls for. Some prefer rock salt for this purpose, in which case a lump is placed where the animals can lick it. Others consider ordinary stock salt more satisfactory. The practice of salting only at intervals of one or two weeks is not to be recommended.

Salt may also be supplied by mixing it with the grain ration in proper proportion. When salt is mixed with the feed, the amount added is from 10 to 12 pounds to 1000 pounds of grain. As a rule this amount will not fully supply the wants of the cow and she should in addition be allowed access to salt and will consume such amounts as her appetite calls for in addition to that in the grain.

Calcium and phosphorus.—The attention of dairy cattle feeders has been drawn sharply to the importance of minerals in the ration. Evidence has been accumulating to show that the mineral content in the ration must be given attention, but the importance, so far as ordinary conditions are concerned, is being overestimated. Undoubtedly the rations fed in some herds are such that the cows suffer from a deficiency of mineral matter. The results may be a general lack of thrift, poor milk production, and possibly in extreme cases troubles with breeding and calves weak at birth. However, in many cases the owner has the question of minerals brought to his attention by the advertising of commercial mixtures and when the results from his cows are not satisfactory, he is led to believe that the remedy lies in feeding mineral supplements. In most cases the real cause of the trouble is poor feeding of the usual kind, a shortage of protein or of total feed.

When are minerals needed?—If dairy cows receive legume hay—clover, alfalfa, or sweet clover—in the winter and are on pasture in the summer no fear need be felt concerning a possible lack of minerals unless some positive indication is observed in the way of an abnormal appetite. If the animals, especially the cows in milk, chew at wood or dirt, and eat bones when given the chance, the ration is probably lacking in mineral matter. There is much more danger of shortage of minerals with very heavily milking cows or when the roughage in the ration is timothy or wild hay.

What minerals may be lacking?—The minerals used chiefly by animals are calcium (lime) and phosphorus. Legume hays are the best source of calcium and grains, of phosphorus. One pound of alfalfa hay contains as much calcium as 100 pounds of corn and almost as much as 10 pounds of timothy.

As a source of phosphorus, wheat bran and cottonseed meal are especially good, while corn, linseed meal, and oats supply this material in fair amounts.

Storage of mineral matter.—It is important to understand that a cow may produce milk for some time, perhaps for several months, without having enough minerals in her feed. This is possible by drawing on the reserve which is stored in the bones. When a heavily milking cow is given timothy or wild hay and grain, either with or without silage, she is compelled to draw on her reserve. No harm is done if she is given a chance later to replace the material taken from her bones. It has been found that the reserve is replaced only when the cow is dry or nearly so, and that it takes place best when the animal is on grass. This shows the importance of feeding the cow well while dry, and if a mineral supplement is fed it is especially important that the animal receive it while on grass.

Is it advisable to feed minerals when no legume hay is fed?—The advisability of using mineral supplements when no legume hay is fed depends upon so many conditions that no definite rule can be given. Under such feeding conditions apparently cows are dangerously short in minerals at times, especially during the period of winter feeding. The most danger is when cows of high producing ability are fed liberally with concentrates for high milk production. No injurious results are to be feared from supplying additional mineral matter in the form of lime or lime and phosphorus, and the results may be decidedly beneficial. Free access to bonemeal is possibly the plan to be most highly recommended. Bonemeal, finely ground limestone, or wood ashes mixed in the grain ration at the rate of 2 pounds to 100, would also be practical and economical sources of lime. Care should be taken to use only limestone high in calcium and low in magnesium, or

the results may be injurious rather than beneficial. Information may generally be had from the experiment station as to the nature of the limestone available in the various counties of the state.

Use of bonemeal.—When cattle show abnormal appetites something is lacking. It may be either calcium or phosphorus. It is not practical to add phosphorus alone. In these cases the use of bonemeal is recommended, the kind prepared especially for stock feeding. This product contains both calcium and phosphorus in the proportion used in the body. It is sold by the large packing houses under the name of "raw bonemeal for feeding" or "poultry bonemeal." It is not raw, however, but thoroly cooked and free from any danger of disease. The finely ground should be specified. The trade name "Steamed Bone Meal" is applied by most packing houses to a low-grade product designed for fertilizer. This grade may have such a strong odor that animals will not eat it. A high-grade product suitable for feeding is also sold as a by-product from certain gelatin factories under the name "Special Steamed Bone Meal."

Bonemeal may be fed like salt by allowing free access to it in the pure form or it may be mixed with salt at the rate of one part salt to four of bonemeal. For a herd of 10 or 12 cows, about 700 pounds of bonemeal will be sufficient for a year.

Spent bone black.—Spent bone black, a waste product from sugar refineries, serves the same purpose as bonemeal. It varies in content of calcium phosphate from 30 to 70 per cent, compared with 48 per cent in bonemeal. The safest plan is to purchase this product only on a guaranteed analysis.

Commercial mineral compounds.—Many prepared mixtures are on the market and greatly exaggerated claims are made as to their value. No better results can be expected from them than from bonemeal or simple mixtures of bonemeal and limestone. In some cases a large amount of cheap material of no value to the animal is included in the mixture. There is no reason for paying a high price for a mixture which contains a large amount of common salt and ground limestone.

Iodin.—Occasionally cattle suffer from a lack of iodin in the ration. This appears as goiter in calves at birth, or with swine, as hairless pigs. The indication of goiter in calves is a swelling in the neck at birth. Sometimes this may be so severe as to cause death, but usually the calf recovers shortly, altho the swelling may remain until the animal reaches maturity. When this trouble is experienced in a herd, iodin should be added to the feed of the pregnant cows. The Division of Veterinary Medicine recommends using either sodium or potassium iodide which may be given in the feed daily in one-grain doses or once a week in 7-grain doses. A small amount of iodin regularly fed will prevent goiter. Iodin should be given to all cows in calf, beginning immediately after breeding and continuing until the cow is ready to calve. A sample dose should be obtained at the time of purchase and may be used in determining the correct amount to be used. The drug should be kept in a tightly corked bottle, properly labeled, and placed in a cabinet near or in the feed room.

USE OF FEEDING STANDARD AND CALCULATION OF RATIONS

A dairy cow uses feed for two purposes: (1) for maintaining the body; (2) to supply the material for milk. In addition, a small amount is required to develop the fetus, and for growth if the animal is immature. The amount required for these purposes is so small that it is taken care of by making the allowance for other purposes rather liberal.

For each of the two important purposes three general classes of food material are required: (1) protein, (2) carbohydrates and fat, (3) mineral matter. It is clear that if it is known how much an animal requires of each of these classes of substances, and if information is at hand as to how much of each is contained in the feeds to be used, it would be possible to figure out a ration that would supply what is needed to meet her requirements.

Fortunately, information on both of these points has been accumulated over a period of many years. It is possible as a result to calculate with reasonable accuracy

the requirements of a certain animal and by making use of the information available regarding the digestible constituents of feeds, to prepare a ration that will supply what is needed.

When a chemist analyses feed, he first determines how much is water and how much is dry matter. All feeds, even those apparently dry, like corn or hay, contain from 10 to 15 per cent water. Roots like beets contain about 90 per cent water.

Water in the feed serves the same purpose as ordinary water consumed by the animal. The chemist divides the dry matter of the feed into protein, crude fiber, nitrogen-free extract, fat, and mineral matter. Analyses are available showing the proportion of these constituents in all common feeds. However, the animal can not utilize all the material found in the feed, that is, only a portion is digestible. This proportion varies with the feed and for the different constituents and has to be determined experimentally. This has also been done for practically all common feeds.

The digestible part of the feed when taken into the body serves two quite distinct purposes. The protein forms the skin, hair, horns, and muscular tissues of the body as well as the curd of the milk. All animals require protein in their rations, and no other element can take its place. Carbohydrates and fats make up the greater portion of the digestible nutrients and serve the body by producing heat to keep the body warm, fat to be stored in the tissues as body fat or put into milk as butterfat, substance from which milk sugar is formed, and energy to keep up the body functions. Both carbohydrates and fats are found in large quantities in most of our common feeds. Neither of these can take the place of protein in a ration. The mineral matter, while important, as shown by the discussion on another page, is not taken into account in the feeding standard.

Feeding standards.—It is known that the cow needs all the constituents mentioned and that they are found in varying proportion in feeds. The next question is how much of each constituent is needed to supply what the cow must have to enable her to produce the maximum amount of

milk. The first attempt to determine the requirements of the animal for protein, carbohydrates, and fat was made more than three quarters of a century ago. Improvements were made from time to time by different investigators. Among those who have made important contributions to this knowledge is Professor T. L. Haecker, who formulated a feeding standard based on twenty years of experimental work and which was a decided step in advance as it takes into account the richness of the milk produced. The requirements in his standard are expressed in terms of digestible crude protein, digestible carbohydrates, and digestible fat. The calculation of rations as given in this bulletin is based upon Professor Haecker's feeding standard except that it has been simplified by combining the three terms used in his standard into two terms, crude protein and total digestible nutrients. The Haecker standard modified as stated is found in Table 2.

Calculating rations.—The feed furnished an animal during a period of 24 hours is known as a ration. In order to calculate a ration for dairy cows it is first necessary to know the amounts of protein and total digestible nutrients required. These requirements vary with the weight of the cow and the amount and richness of the milk produced. Therefore it is necessary to know the weight of the cow, the pounds of milk produced, and the test of the milk. For the sake of simplicity, the ration figured out in these paragraphs will deal with an individual cow. Suggestions for its use in figuring out rations for a herd are found in a later paragraph.

Using the tables.—The first thing is to find the requirements of the animal. To do this add the amount needed for the maintenance of the animal, as given in Table 1, to the amount needed for the milk she is producing, as shown in Table 2. As an illustration, let it be assumed that the cow under consideration weighs 1100 pounds and is producing daily 25 pounds of 4 per cent milk. Table 1 shows that the maintenance requirements for a cow of this weight are 0.770 pound digestible crude protein and 8.718 pounds total digestible nutrients. Table 2 shows the requirements in addition to maintenance for producing milk. As figures for 25 pounds are not given,

the figures for 5 and 20 pounds are added together giving a total of 1.350 pounds of digestible crude protein and 8.530 pounds total digestible nutrients. As a matter of convenience, the figures for maintenance and for milk are written in the form below and added to obtain the total requirement of the cow.

Requirements	Digestible crude protein lbs.	Total digestible nutrients lbs.
For maintenance	0.770	8.717
For 25 lbs. 4 per cent milk	1.350	8.530
Total	2.120	17.247

The total shows that the daily ration of a cow weighing 1100 pounds and giving 25 pounds of 4 per cent milk, should contain approximately 2.120 pounds of digestible crude protein and 17.25 pounds total digestible nutrients.

Selecting the ration.—Now that the requirements of the cow have been found, the next step is to select a ration which will supply these requirements and at the same time be economical and practical. In selecting the feeds use is made of the composition of feeds as given in Table 3.

Let it be assumed that the feeds available are red clover hay, corn silage, and corn. A cow usually takes about one pound of hay and 3 pounds of silage daily per 100 pounds of live weight. On this basis for the roughage part of the ration a reasonable allowance would be 11 pounds of clover hay and 33 pounds of silage. The next step is to add what would appear to be a reasonable feed of corn and find how near the hay, silage, and corn would meet the requirements. In accordance with the rules for feeding given previously, 8 pounds of corn is chosen for the trial ration. The figures below show the protein and total digestible nutrients supplied by each part of the ration and the total.

Feeds furnished	Digestible crude protein lbs.	Total digestible nutrients lbs.
Clover hay, 11 pounds	0.811	5.456
Corn silage, 33 pounds	0.396	5.544
Ground corn, 8 pounds	0.568	6.536
Total supplied	1.775	17.536
Required	2.120	17.247

The trial ration given meets the requirements for the total digestible nutrients fairly satisfactorily, but it is short 0.345 pound of digestible crude protein. This shows that the trial ration is too low in protein and that some feed high in protein should be substituted in part for the ground corn. By referring to the market prices of feeds and Table 4, it will be seen that linseed meal and cottonseed meal are among the cheapest sources of protein. For this reason 1.5 pounds of linseed meal is substituted for the same amount of cornmeal, and the protein and total digestible nutrients are again calculated as follows:

Feeds furnished	Digestible crude protein	Total digestible nutrients
	lbs.	lbs.
Clover hay, 11 pounds	0.811	5.456
Corn silage, 33 pounds	0.396	5.544
Ground corn, 6.5 pounds	0.461	5.310
Linseed meal, 1-5 pounds	0.453	1.174
Total	2.121	17.484
Required	2.120	17.248

The second trial ration exactly meets the digestible crude protein requirement and is considered close enough for the total digestible nutrients. The amount of nutrients furnished in the ration should not vary more than 5 per cent from the amount set forth in the requirements. When feeding practices are within these limits, satisfactory results will follow.

While the second trial ration furnishes the protein and total digestible nutrients in the proper amounts, it could be improved by adding a feed that would add bulk to the grain mixture. Such feeds as oats, wheat bran, and dried beet pulp are bulky and the addition of any one of these would give us a grain mixture that is less pasty than that in trial ration No 2. Usually wheat bran is just as cheap as oats, but as oats is so generally used we will replace some of the corn in ration No. 2 with ground oats. From 1 to 3 pounds of oats could be fed in this ration and furnish the required bulk. For this trial it will be well to replace 1.5 pounds of corn with 1.5 pounds of oats. We then have the following:

Feeds furnished	Digestible crude protein lbs.	Total digestible nutrients lbs.
Clover hay, 11 pounds	0.811	5.456
Corn silage, 33 pounds	0.396	5.544
Ground corn, 5 pounds	0.355	4.085
Ground oats, 1.5 pounds	0.145	1.056
Linseed meal, 1.5 pounds	0.453	1.174
Total	2,160	17.315
Required	2.120	17.246

The nutrients furnished in the third trial ration fulfil the requirements set forth by the Haecker standard. In addition to meeting the requirements of the feeding standard, it furnishes a palatable ration with a variety of feeds, the proper bulk, and one succulent feed—the combination furnishing an economical ration.

Using the standard to figure a ration for the herd.—The preceding discussion has dealt with a ration for an individual cow. When the question is that of feeding a herd, it is clearly impossible to figure a ration for every animal. One way to solve this is to figure a ration for a typical animal in the herd. In determining what a typical animal is, it is advisable to use an average figure for the weight of the animals, amount of milk produced, and if the herd consists of one breed only, the average test may also be used. By following the method illustrated it is fairly easy to calculate a ration that will meet the requirements for the average cow in the herd. But if all the cows receive equal quantities of feed, some will be overfed while others will be underfed. Poor results will be experienced in either case. Therefore it is necessary to vary the roughages in proportion to the live weight and the grain according to the amount of milk produced. Recommendations as to the amounts to feed can be found on pages 9 and 10. Rations figured in this manner will be slightly low in protein for high-producing cows and somewhat high for low-producing cows, but the error will not be serious.

Table 1. Daily Maintenance Requirements for Dairy Cows

Weight lbs.	Digestible crude protein lbs.	Total digestible nutrients lbs.
800	0.560	6.340
850	0.595	6.725
900	0.630	7.132
950	0.665	7.517
1000	0.700	7.925
1050	0.735	8.310
1100	0.770	8.717
1150	0.805	9.102
1200	0.840	9.500
1250	0.875	9.895
1300	0.910	10.302
1350	0.945	10.687
1400	0.980	11.095
1450	1.015	11.480
1500	1.055	11.887

Table 2. Haecker's Feeding Standard

Nutrients Required for Producing Milk in Addition to Maintenance

Per cent fat in milk 3.0			Per cent fat in milk 3.5		
Amount of milk	Digestible protein	Total digestible nutrients	Amount of milk	Digestible protein	Total digestible nutrients
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	0.047	0.285	1	0.049	0.312
5	0.235	1.426	5	0.245	1.558
10	0.470	2.852	10	0.490	3.117
20	0.940	5.704	20	0.980	6.234
30	1.410	8.556	30	1.470	9.351
40	1.880	11.408	40	1.960	12.468
50	2.350	14.260	50	2.450	15.585
60	2.820	17.112	60	2.940	18.702
Per cent fat in milk 4.0			**Per cent fat in milk 4.5**		
1	0.054	0.341	1	0.057	0.369
5	0.270	1.706	5	0.285	1.843
10	0.540	3.412	10	0.570	3.687
20	1.080	6.824	20	1.140	7.374
30	1.620	10.236	30	1.710	11.061
40	2.160	13.648	40	2.280	14.748
50	2.700	17.060	50	2.850	18.435
60	3.240	20.472			

Table 2—Continued

Amount of milk	Digestible protein	Total digestible nutrients	Amount of milk	Digestible protein	Total digestible nutrients
Per cent fat in milk 5.0			Per cent fat in milk 5.5		
1.....	0.060	0.394	1.....	0.064	0.422
5.....	0.300	1.970	5.....	0.320	2.112
10.....	0.600	3.940	10.....	0.640	4.225
20.....	1.200	7.880	20.....	1.280	8.450
30.....	1.800	11.820	30.....	1.920	12.675
40.....	2.400	15.760	40.....	2.560	16.900
Per cent fat in milk 6.0			Per cent fat in milk 6.5		
1.....	0.670	0.450	1.....	0.072	0.477
5.....	0.335	2.250	5.....	0.360	2.386
10.....	0.670	4.500	10.....	0.720	4.772
20.....	1.340	9.000	20.....	1.440	9.544
30.....	2.010	13.500	30.....	2.160	14.316
40.....	2.680	18.000	40.....	2.880	19.088

Table 3. Nutrients Contained in a Given Number of Pounds of the Most Important Feeds

Dry Roughages					
Mixed Hay (½ clover, ½ timothy)			Soybean Hay		
Amount	Digestible crude protein	Total digestible nutrients	Amount	Digestible crude protein	Total digestible nutrients
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
5.....	0.254	2.463	5.....	0.530	2.715
6.....	0.305	2.956	6.....	0.636	3.258
7.....	0.356	3.448	7.....	0.742	3.801
8.....	0.407	3.941	8.....	0.848	4.344
9.....	0.458	4.434	9.....	0.954	4.887
10.....	0.509	4.927	10.....	1.060	5.430
11.....	0.559	5.419	11.....	1.166	5.973
12.....	0.610	5.912	12.....	1.272	6.516
13.....	0.661	6.405	13.....	1.378	7.059
14.....	0.712	6.897	14.....	1.484	7.602
15.....	0.763	7.390	15.....	1.590	8.145

Table 3—Continued

Dry Roughages

Amount	Digestible crude protein	Total digestible nutrients
Red Clover Hay		
lbs.	lbs.	lbs.
5	0.369	2.480
6	0.442	2.976
7	0.516	3.472
8	0.590	3.968
9	0.664	4.464
10	0.738	4.960
11	0.811	5.456
12	0.885	5.952
13	0.959	6.448
14	1.033	6.944
15	1.107	7.440
Alfalfa Hay		
5	0.529	2.550
6	0.634	3.060
7	0.740	3.570
8	0.846	4.080
9	0.952	4.590
10	1.058	5.101
11	1.163	5.611
12	1.269	6.121
13	1.375	6.631
14	1.481	7.141
15	1.587	7.651
Corn Fodder		
5	0.185	2.404
6	0.222	2.884
7	0.259	3.365
8	0.296	3.846
9	0.333	4.327
10	0.370	4.808
11	0.407	5.288
12	0.444	5.769
13	0.481	6.250
14	0.518	6.731
15	0.555	7.212

Amount	Digestible crude protein	Total digestible nutrients
Alsike Hay		
lbs.	lbs.	lbs.
5	0.395	2.365
6	0.474	2.838
7	0.553	3.311
8	0.632	3.784
9	0.711	4.257
10	0.790	4.730
11	0.869	5.203
12	0.948	5.676
13	1.027	6.149
14	1.106	6.622
15	1.185	7.095
Sweet Clover Hay		
5	0.545	2.535
6	0.654	3.042
7	0.763	3.549
8	0.872	4.056
9	0.981	4.563
10	1.090	5.070
11	1.199	5.577
12	1.308	6.084
13	1.417	6.591
14	1.526	7.098
15	1.635	7.605
Corn Stover		
5	0.990	1.821
6	1.188	2.185
7	1.386	2.549
8	1.584	2.913
9	1.782	3.277
10	1.980	3.642
11	2.178	4.006
12	2.376	4.370
13	2.574	4.734
14	2.772	5.098
15	2.970	5.463

Table 3—Continued

Amount	Digestible crude protein	Total digestible nutrients
Timothy Hay		
lbs.	lbs.	lbs.
5.....	0.140	2.447
6.....	0.168	2.937
7.....	0.196	3.426
8.....	0.224	3.916
9.....	0.252	4.405
10.....	0.280	4.895
11.....	0.308	5.384
12.....	0.336	5.874
13.....	0.364	6.363
14.....	0.392	6.853
15.....	0.420	7.342
Prairie Hay		
5.....	0.150	2.407
6.....	0.180	2.890
7.....	0.210	3.370
8.....	0.240	3.852
9.....	0.270	4.335
10.....	0.300	4.815
11.....	0.330	5.296
12.....	0.360	5.778
13.....	0.390	6.259
14.....	0.420	6.741
15.....	0.450	7.222
Corn Silage		
1.....	0.012	0.168
2.....	0.024	0.336
3.....	0.036	0.504
4.....	0.048	0.672
5.....	0.060	0.840
6.....	0.072	1.008
7.....	0.084	1.176
8.....	0.096	1.344
9.....	0.108	1.512
10.....	0.120	1.680
20.....	0.240	3.360
30.....	0.360	5.040
40.....	0.480	6.720

Amount	Digestible crude protein	Total digestible nutrients
Redtop Hay		
lbs.	lbs.	lbs.
5.....	0.240	2.702
6.....	0.288	3.243
7.....	0.336	3.782
8.....	0.384	4.324
9.....	0.432	4.862
10.....	0.480	5.405
11.....	0.528	5.945
12.....	0.576	6.486
13.....	0.624	7.026
14.....	0.672	7.567
15.....	0.720	8.107
Oat Hay		
5.....	0.235	2.276
6.....	0.282	2.731
7.....	0.329	3.186
8.....	0.376	3.641
9.....	0.423	4.096
10.....	0.470	4.552
11.....	0.517	5.007
12.....	0.564	5.462
13.....	0.611	5.917
14.....	0.658	6.372
15.....	0.705	6.828
Succulent Feeds		
Sunflower Silage		
1.....	0.010	0.126
2.....	0.020	0.252
3.....	0.030	0.378
4.....	0.040	0.504
5.....	0.050	0.630
6.....	0.060	0.756
7.....	0.070	0.882
8.....	0.080	1.008
9.....	0.090	1.134
10.....	0.100	1.260
20.....	0.200	2.520
30.....	0.300	3.780
40.....	0.400	5.040

Table 3—Continued

Amount	Digestible crude protein	Total digestible nutrients	Amount	Digestible crude protein	Total digestible nutrients
	Potatoes			Sugar Beets	
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1.....	0.011	0.173	1.....	0.013	0.115
2.....	0.022	0.346	2.....	0.026	0.230
3.....	0.033	0.519	3.....	0.039	0.345
4.....	0.044	0.692	4.....	0.052	0.460
5.....	0.055	0.866	5.....	0.065	0.576
6.....	0.066	1.039	6.....	0.078	0.691
7.....	0.077	1.212	7.....	0.091	0.806
8.....	0.088	1.385	8.....	0.104	0.921
9.....	0.099	1.558	9.....	0.117	1.036
10.....	0.110	1.732	10.....	0.130	1.152
20.....	0.220	3.464	20.....	0.260	2.304
30.....	0.330	5.196	30.....	0.390	3.456
40.....	0.440	6.928	40.....	0.520	4.608
	Mangels			Rutabagas	
1.....	0.010	0.064	1.....	0.010	0.094
2.....	0.020	0.129	2.....	0.020	0.189
3.....	0.030	0.193	3.....	0.030	0.283
4.....	0.040	0.258	4.....	0.040	0.378
5.....	0.050	0.322	5.....	0.050	0.472
6.....	0.060	0.387	6.....	0.060	0.567
7.....	0.070	0.451	7.....	0.070	0.661
8.....	0.080	0.516	8.....	0.080	0.756
9.....	0.090	0.580	9.....	0.090	0.850
10.....	0.100	0.645	10.....	0.100	0.945
20.....	0.200	1.290	20.....	0.200	1.890
30.....	0.300	1.935	30.....	0.300	2.835
40.....	0.400	2.580	40.....	0.400	3.780
Concentrates Low in Protein and High in Total Digestible Nutrients					
	Corn, Dent			Corn and Cob Meal	
¼.....	0.017	0.204	¼.....	0.015	0.193
½.....	0.035	0.408	½.....	0.030	0.390
1.....	0.071	0.817	1.....	0.061	0.781
2.....	0.142	1.634	2.....	0.122	1.562
3.....	0.213	2.451	3.....	0.183	2.343
4.....	0.284	3.268	4.....	0.244	3.124
5.....	0.355	4.085	5.....	0.305	3.905
6.....	0.426	4.902	6.....	0.366	4.686
7.....	0.497	5.719	7.....	0.427	5.467
8.....	0.568	6.536	8.....	0.488	6.248
9.....	0.639	7.353	9.....	0.549	7.029
10.....	0.710	8.170	10.....	0.610	7.810

Table 3—Continued

Concentrates Low in Protein and High in Total Digestible Nutrients

Amount	Digestible crude protein	Total digestible nutrients
	Corn, Flint	
lbs.	lbs.	lbs.
¼	0.011	0.210
½	0.023	0.421
1	0.046	0.842
2	0.092	1.684
3	0.138	2.526
4	0.184	3.368
5	0.230	4.210
6	0.276	5.052
7	0.322	5.894
8	0.368	6.736
9	0.414	7.578
10	0.460	8.420
	Oats	
¼	0.024	0.176
½	0.048	0.352
1	0.097	0.704
2	0.194	1.408
3	0.291	2.112
4	0.388	2.816
5	0.485	3.520
6	0.582	4.224
7	0.679	4.928
8	0.776	5.632
9	0.873	6.336
10	0.970	7.040
	Rye	
¼	0.023	0.204
½	0.045	0.409
1	0.091	0.819
2	0.182	1.638
3	0.273	2.457
4	0.364	2.476
5	0.456	4.095
6	0.547	4.914
7	0.638	5.733
8	0.729	6.552
9	0.820	7.371
10	0.912	8.191

Amount	Digestible crude protein	Total digestible nutrients
	Barley	
lbs.	lbs.	lbs.
¼	0.022	0.198
½	0.045	0.397
1	0.090	0.794
2	0.180	1.588
3	0.270	2.382
4	0.360	3.176
5	0.450	3.970
6	0.540	4.764
7	0.630	5.558
8	0.720	6.352
9	0.810	7.146
10	0.900	7.940
	Wheat	
¼	0.022	0.197
½	0.044	0.395
1	0.088	0.791
2	0.176	1.583
3	0.264	2.375
4	0.352	3.166
5	0.440	3.958
6	0.528	4.750
7	0.616	5.541
8	0.704	6.333
9	0.792	7.123
10	0.880	7.917
	Dried Beet Pulp	
¼	0.011	0.179
½	0.023	0.358
1	0.046	0.716
2	0.092	1.432
3	0.138	2.148
4	0.184	2.864
5	0.230	3.580
6	0.276	4.296
7	0.322	5.012
8	0.368	5.728
9	0.414	6.444
10	0.460	7.160

Table 3—Continued

Concentrates Medium to High in Protein

Amount	Digetsible crude protein	Total digestible nutrients	Amount	Digestible crude protein	Total digestible nutrients
	Wheat Bran			Gluten Feed	
	lbs.	lbs.		lbs.	lbs.
¼	0.030	0.149	¼	0.053	0.202
½	0.060	0.298	½	0.106	0.404
1	0.120	0.596	1	0.213	0.808
2	0.240	1.193	2	0.426	1.616
3	0.360	1.790	3	0.639	2.424
4	0.480	2.387	4	0.852	3.232
5	0.600	2.984	5	1.065	4.041
6	0.720	3.581	6	1.278	4.849
7	0.840	4.178	7	1.491	5.657
8	0.960	4.775	8	1.704	6.465
9	1.080	5.372	9	1.917	7.273
10	1.201	5.969	10	2.130	8.082
	Gluten Meal			Linseed Meal	
¼	0.074	0.214	¼	0.075	0.195
½	0.148	0.429	½	0.151	0.391
1	0.297	0.858	1	0.302	0.783
2	0.594	1.716	2	0.604	1.566
3	0.891	2.574	3	0.906	2.349
4	1.188	3.432	4	1.208	3.132
5	1.485	4.290	5	1.510	3.196
	Ground Soybeans			Cottonseed Meal	
¼	0.072	0.212	¼	0.094	0.200
½	0.145	0.424	½	0.188	0.401
1	0.291	0.849	1	0.376	0.802
2	0.582	1.699	2	0.752	1.604
3	0.873	2.548	3	1.128	2.406
4	1.164	3.398	4	1.504	3.208
5	1.455	4.247	5	1.880	4.010

Note: Analyses given in Table 4 are mainly from Minnesota Experiment Station Bulletin 130 and Farmers Bulletin No. 22, U. S. Dept. of Agr. For analyses of feeds not given in this list, the reader is referred to Feeds and Feeding by Henry and Morrison. Bulletin 130 is no longer available.

Table 4. Average Digestible Nutrients in 100 Pounds of the Common Feeds

Kind of feed	Digestible crude protein	Total digestible nutrients
	lbs.	lbs.
Concentrates (low in protein)		
Corn, dent	7.1	81.7
Corn, flint	4.6	84.2
Corn and cob meal	6.1	78.1
Barley	9.0	79.4
Oats	9.7	70.4
Wheat	8.8	79.2
Rye	9.1	81.9
Dried beet pulp	4.6	71.6
Molasses, beet	2.9	58.7
Molasses, cane	1.0	59.5
Concentrates (medium to high in protein)		
Wheat bran	12.0	59.7
Wheat middlings (standard)	13.4	69.3
Gluten feed	21.3	80.8
Gluten meal	29.7	85.8
Linseed meal	30.2	78.3
Ground soybeans	29.1	84.9
Cottonseed meal	37.6	80.2
Flax seed	20.6	102.8
Brewers' grains, dried	21.5	65.7
Dry roughages (low in protein)		
Wheat straw	0.7	36.9
Oat straw	1.0	45.6
Corn fodder	3.7	48.1
Corn stover	2.0	36.4
Timothy hay	2.8	48.9
Redtop hay	4.8	54.1
Prairie hay	3.0	48.2
Oats hay	4.7	45.5
Dry roughages (medium to high in protein)		
Mixed hay (½ clover, ½ timothy)	5.1	49.3
Oat and pea hay	7.6	52.1
Red clover hay	7.4	49.6
Alsike clover hay	7.9	47.3
Alfalfa hay	10.6	51.0
Soybean hay	10.6	54.3
Sweet clover hay	10.9	50.7
Succulent feeds		
Corn silage	1.2	16.8
Sunflower silage	1.0	12.6
Potatoes	1.1	17.3
Sugar beets	1.3	11.5
Mangels	1.0	6.5
Rutabagas	1.0	9.5
Beets, common	0.9	10.2

Table 5. Comparative Cost of Digestible Crude Protein

Cost of feed per ton, dollars			10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	44	48	52	56	60
Feed	Composition of 100 lbs. feed: Digestible crude protein	Total digestible nutrients	Cost of one pound digestible crude protein, cents																				
	lbs.	lbs.																					
Cottonseed meal	37.6	80.2	1.3	1.6	1.8	2.1	2.4	2.6	2.9	3.2	3.5	3.7	4.0	4.3	4.5	4.8	5.1	5.3	5.8	6.4	6.9	7.4	7.9
Linseed meal	30.2	78.3	1.7	2.0	2.3	2.6	3.0	3.3	3.6	4.0	4.3	4.6	5.0	5.3	5.6	6.0	6.3	6.6	7.3	7.9	8.6	9.3	9.9
Ground soybeans..	29.1	84.9	1.7	2.1	2.4	2.7	3.1	3.4	3.7	4.1	4.4	4.8	5.2	5.5	5.8	6.2	6.5	6.9	7.6	8.2	8.9	9.6	10.3
Gluten meal.	29.7	85.8	1.7	2.0	2.3	2.6	3.0	3.3	3.6	4.0	4.3	4.7	5.1	5.4	5.7	6.1	6.4	6.7	7.4	8.0	8.7	9.4	10.1
Gluten feed..	21.3	80.8	2.3	2.8	3.3	3.8	4.2	4.7	5.2	5.6	6.1	6.6	7.0	7.5	8.0	8.5	8.9	9.4	10.3	11.3	12.2	13.1	14.1
Wheat bran.	12.0	59.7	4.2	5.0	5.8	6.6	7.5	8.3	9.2	10.0	10.8	11.7	12.5	13.3	14.2	15.0	15.8	16.7	18.3	20.0	21.7	23.3	25.0
Oats	9.7	70.4	5.2	6.2	7.2	8.2	9.3	10.3	11.3	12.4	13.4	14.4	15.5	16.5	17.5	18.6	19.6	20.6	22.7	24.7	26.8	28.8	30.9
Corn, dent..	7.1	81.7	7.0	8.4	9.9	11.3	12.7	14.1	15.5	16.9	18.3	19.7	21.1	22.5	23.9	25.4	26.8	28.2	31.0	33.8	36.6	39.4	42.2
Barley	9.0	79.4	5.6	6.7	7.8	8.9	10.0	11.1	12.2	13.3	14.4	15.5	16.7	17.8	18.9	20.0	21.1	22.2	24.4	26.7	28.9	31.1	33.3
Alfalfa hay.	10.6	51.0	4.7	5.6	6.6	7.5	8.5	9.4	10.4	11.3	12.3	13.2	14.1										
Red clover hay	7.4	49.6	6.6	8.1	9.5	10.8	12.2	13.5	14.9	16.2	17.6	18.9	20.3										
Timothy hay	2.8	48.9	17.8	21.4	25.0	28.5	32.1	35.7	39.3	42.9	46.4	50.0	53.6										

Table 6. Comparative Cost of Total Digestible Nutrients

Cost of feed per ton, dollars			10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
Feed	Composition of 100 lbs. feed: Digestible crude protein	Total digestible nutrients	Cost of one pound total digestible nutrients, cents																				
	lbs.	lbs.																					
Corn, dent..	7.1	81.7	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.5	1.6	1.7	1.8	2.0	2.1	2.2	2.3	2.4	2.6	2.7	2.8	2.9	3.0
Barley	9.0	79.4	0.6	0.8	0.9	1.0	1.1	1.3	1.4	1.5	1.6	1.8	1.9	2.0	2.1	2.2	2.4	2.5	2.6	2.8	2.9	3.0	3.1
Middlings, standard..	13.4	69.3	0.7	0.9	1.0	1.2	1.3	1.4	1.6	1.7	1.9	2.0	2.2	2.3	2.5	2.6	2.7	2.9	3.0	3.2	3.3	3.5	3.6
Rye	9.1	81.9	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.5	1.6	1.7	1.8	2.0	2.1	2.2	2.3	2.4	2.6	2.7	2.8	2.9	3.0
Oats	9.7	70.4	0.7	0.9	1.0	1.2	1.3	1.4	1.5	1.6	1.8	1.9	2.1	2.2	2.4	2.5	2.6	2.8	2.9	3.1	3.2	3.4	3.5
Bran, wheat	12.0	59.7	0.8	1.0	1.2	1.3	1.5	1.7	1.8	2.0	2.2	2.3	2.5	2.7	2.8	3.0	3.2	3.4	3.5	3.7	3.9	4.0	4.2
Beet pulp..	4.6	71.6	0.7	0.8	1.0	1.1	1.2	1.4	1.5	1.6	1.8	1.9	2.1	2.2	2.4	2.5	2.6	2.8	2.9	3.0	3.2	3.4	3.5
Molasses ...	2.9	58.7	0.9	1.0	1.2	1.4	1.5	1.7	1.8	2.0	2.2	2.3	2.5	2.7	2.8	3.0	3.2	3.4	3.6	3.7	3.9	4.1	4.3
Alfalfa hay.	10.6	51.0	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.5	2.7	2.9										
Red clover hay	7.4	49.6	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0										
Timothy hay	2.8	48.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0										
*Corn silage	1.2	16.8	3.0																				

* For each dollar silage is valued below $10, subtract 0.3f a cent from 3.0 cents. Example, for silage at $5 subtract 1.5 cents from 3.0 cents, giving the cost of a pound of digestible nutrients as 1.5 cents.

Table 7. Average Weight of One Quart of Feed

Feed	Weight	Feed	Weight
	lbs.		lbs.
Corn (unground)	1.75	Barley (unground)	1.01
Corn meal	1.31	Brewers' dried grains	0.67
Hominy feed	1.50	Buckwheat (unground)	1.43
Gluten feed	1.50	Buckwheat middlings	0.92
Gluten meal	1.65	Flaxseed (unground)	1.65
Germ oil meal	1.35	Flaxseed meal	1.10
Distillers' dried grain	0.63	Linseed meal, old process	1.33
Corn and cob meal	1.50	Cottonseed meal	1.50
Oats (unground)	1.03	Blood meal	1.87
Oat meal	1.67	Alfalfa meal	0.59
Wheat, whole	1.90	Dried beet pulp	0.65
Wheat bran	0.55	Canada field peas	2.09
Wheat middlings	1.00	Field beans	1.71
Flour middlings	1.12	German millet seed	1.59
Rye (unground)	1.85	Soybeans	1.81
Rye middlings	1.55	Sunflower seed	1.51

Tables 8 and 9 are made to aid in determining the cost of a ration. If it is desired to ascertain the cost of a pound of oats when it sells for 23 cents per bushel, follow the column under the heading "When a Bushel Costs" until the number 23 is reached; then to the right to the column headed "32" because there are 32 pounds to a bushel, where 0.719 cents is given as the price of 1 pound of oats.

Table 8. Cost of One Pound of Feed at a Given Price Per Ton

Price per ton	Cost of 1 lb.	Price per ton	Cost of 1 lb.	Price per ton	Cost of 1 lb.
	Cents		Cents		Cents
$ 3.00	.150	$20.00	1.000	$44.50	2.225
3.25	.162	20.50	1.025	45.00	2.250
3.50	.175	21.00	1.050	45.50	2.275
3.75	.187	21.50	1.075	46.00	2.300
4.00	.200	22.00	1.100	46.50	2.325
4.25	.212	22.50	1.125	47.00	23.50
4.50	.225	23.00	1.150	47.50	2.375
4.75	.237	24.00	1.200	48.00	2.400
5.00	.250	24.50	1.225	48.50	2.425
5.25	.262	25.00	1.250	49.00	2.450
5.50	.275	25.50	1.275	49.50	2.475
5.75	.287	26.00	1.300	50.00	2.500
6.00	.300	26.50	1.325	50.50	2.525
6.25	.312	27.00	1.350	51.00	2.550
6.50	.325	27.50	1.375	51.50	2.575
6.75	.337	28.00	1.400	52.00	2.600
7.00	.350	28.50	1.425	52.50	2.625
7.25	.362	29.00	1.450	53.00	2.650
7.50	.375	29.50	1.475	53.50	2.675
7.75	.387	30.00	1.500	54.00	2.700
8.00	.400	30.50	1.525	54.50	2.725
8.25	.412	31.00	1.550	55.00	2.750
8.50	.425	31.50	1.575	55.50	2.775
8.75	.437	32.00	1.600	56.00	2.800
9.00	.450	32.50	1.625	56.50	2.825
9.25	.462	33.00	1.650	57.00	2.850
9.50	.475	33.50	1,675	57.50	2.875
9.75	.487	34.00	1.700	58.00	2.900
10.00	.500	34.50	1.725	58.50	2.925
10.50	.525	35.00	1.750	59.00	2.950
11.00	.550	35.50	1.775	59.50	2.975
11.50	.575	36.00	1.800	60.00	3.000
12.00	.600	36.50	1.825		
12.50	.625	37.00	1.850		
13.00	.650	37.50	1.875		
13.50	.675	38.00	1.900		
14.00	.700	38.50	1.925		
14.50	.725	39.00	1.950		
15.00	.750	39.50	1.975		
15.50	.775	40.00	2.000		
16.00	.800	40.50	2.025		
16.50	.825	41.00	2.050		
17.00	.850	41.50	2.075		
17.50	.875	42.00	2.100		
18.00	.900	42.50	2.125		
18.50	.925	43.00	2.150		
19.00	.950	43.50	2.175		
19.50	.975	44.00	2.200		

Table 9. Cost of One Pound at a Given Price and Weight per Bushel

When a bushel costs	When a bushel weighs 32 lbs.	48 lbs.	56 lbs.	60 lbs.	70 lbs.
	1 lb. costs	1 lb. costs	1 lb. costs	1 lb. costs	1 lb. costs
Cents	Cents	Cents	Cents	Cents	Cents
20	0.625	0.417	0.357	0.333	0.286
21	0.656	0.437	0.375	0.350	0.300
22	0.687	0.458	0.393	0.367	0.314
23	0.719	0.479	0.411	0.383	0.328
24	0.750	0.500	0.428	0.400	0.343
25	0.781	0.521	0.446	0.417	0.357
26	0.812	0.542	0.464	0.433	0.371
27	0.844	0.563	0.482	0.450	0.386
28	0.875	0.583	0.500	0.467	0.400
29	0.906	0.604	0.518	0.483	0.414
30	0.937	0.625	0.536	0.500	0.428
31	0.969	0.646	0.554	0.517	0.443
32	1.000	0.667	0.571	0.533	0.457
33	1.031	0.687	0.589	0.550	0.471
34	1.062	0.708	0.607	0.567	0.486
35	1.094	0.729	0.625	0.583	0.500
36	1.125	0.750	0.643	0.600	0.514
37	1.156	0.771	0.661	0.617	0.528
38	1.187	0.792	0.678	0.633	0.543
39	1.219	0.812	0.696	0.650	0.557
40	1.250	0.833	0.714	0.667	0.571
41	1.281	0.854	0.732	0.683	0.586
42	1.312	0.875	0.750	0.700	0.600
43	1.344	0.896	0.768	0.717	0.614
44	1.375	0.917	0.786	0.733	0.628
45	1.406	0.937	0.804	0.750	0.643
46	1.437	0.958	0.821	0.767	0.657
47	1.469	0.979	0.839	0.783	0.671
48	1.500	1.000	0.857	0.800	0.686
49	1.531	1.021	0.875	0.817	0.700
50	1.562	1.042	0.893	0.833	0.714
51	1.594	1.062	0.911	0.850	0.728
52	1.625	1.083	0.928	0.867	0.743
53	1.656	1.104	0.946	0.883	0.757
54	1.687	1.125	0.964	0.900	0.771
55	1.719	1.146	0.982	0.917	0.786
56	1.750	1.167	1.000	0.933	0.800
57	1.781	1.187	1.018	0.950	0.814
58	1.812	1.208	1.036	0.967	0.828
59	1.844	1.229	1.054	0.983	0.843
60	1.875	1.250	1.071	1.000	0.857
61	1.906	1.271	1.089	1.016	0.871

Table 9. Cost of One Pound at a Given Price and Weight per Bushel—Continued

When a bushel costs	When a bushel weighs				
	32 lbs.	48 lbs.	56 lbs.	60 lbs.	70 lbs.
	1 lb. costs	1 lb. costs	1 lb. costs	1 lb. costs	1 lb. costs
Cents	Cents	Cents	Cents	Cents	Cents
62	1.937	1.292	1.107	1.033	0.886
63	1.969	1.312	1.125	1.050	0.900
64	2.000	1.333	1.143	1.067	0.914
65	2.031	1.354	1.161	1.083	0.928
66	2.062	1.375	1.178	1.100	0.943
67	2.094	1.396	1.196	1.117	0.957
68	2.125	1.417	1.214	1.133	0.971
69	2.156	1.437	1.232	1.150	0.986
70	2.187	1.458	1.250	1.167	1.000
71	2.219	1.479	1.268	1.183	1.014
72	2.250	1.500	1.286	1.200	1.028
73	2.281	1.521	1.303	1.217	1.043
74	2.312	1.542	1.321	1.233	1.057
75	2.344	1.562	1.339	1.250	1.071
76	2.375	1.583	1.357	1.267	1.086
77	2.406	1.604	1.375	1.283	1.100
78	2.437	1.625	1.393	1.300	1.114
79	2.469	1.646	1.411	1.317	1.128
80	2.500	1.667	1.428	1.333	1.143
81	2.531	1.687	1.446	1.350	1.157
82	2.562	1.708	1.464	1.367	1.171
83	2.594	1.729	1.482	1.383	1.186
84	2.625	1.750	1.500	1.400	1.200
85	2.656	1.771	1.518	1.417	1.214
86	2.687	1.792	1.536	1.433	1.228
87	2.719	1.812	1.553	1.450	1.243
88	2.750	1.833	1.571	1.467	1.257
89	2.781	1.854	1.589	1.483	1.271
90	2.812	1.875	1.607	1.500	1.286
91	2.844	1.896	1.625	1.517	1.300
92	2.875	1.917	1.643	1.533	1.314
93	2.906	1.937	1.661	1.550	1.328
94	2.937	1.958	1.678	1.567	1.343
95	2.969	1.979	1.696	1.583	1.357
96	3.000	2.000	1.714	1.600	1.371
97	3.031	2.021	1.732	1.617	1.386
98	3.062	2.041	1.750	1.633	1.400
99	3.094	2.062	1.768	1.650	1.414
100	3.125	2.083	1.786	1.667	1.571

Table 10. Gestation Table*

Date of Service	Date of Birth	Date of Service	Date of Birth	Date of Service	Date of Birth
Jan. 1	Oct. 8	May 6	Feb. 11	Sept. 8	June 16
" 6	" 13	" 11	" 16	" 13	" 21
" 11	" 18	" 16	" 21	" 18	" 26
" 16	" 23	" 21	" 26	" 23	July 1
" 21	" 28	" 26	Mar. 3	" 28	" 6
" 26	Nov. 2	" 31	" 8	Oct. 3	" 11
" 31	" 7	June 5	" 13	" 8	" 16
Feb. 5	" 12	" 10	" 18	" 13	" 21
" 10	" 17	" 15	" 23	" 18	" 26
" 15	" 22	" 20	" 28	" 23	" 31
" 20	" 27	" 25	Apr. 2	" 28	Aug. 5
" 25	Dec. 2	" 30	" 7	Nov. 2	" 10
Mar. 2	" 7	July 5	" 12	" 7	" 15
" 7	" 13	" 10	" 17	" 12	" 20
" 12	" 18	" 15	" 22	" 17	" 25
" 17	" 23	" 20	" 27	" 22	" 30
" 22	" 28	" 25	May 2	" 27	Sept. 4
" 27	Jan. 2	" 30	" 7	Dec. 2	" 9
Apr. 1	" 7	Aug. 4	" 13	" 7	" 14
" 6	" 12	" 9	" 17	" 12	" 19
" 11	" 17	" 14	" 22	" 17	" 24
" 16	" 22	" 19	" 27	" 22	" 29
" 21	" 27	" 24	June 1	" 27	Oct. 4
" 26	Feb. 1	" 20	" 6		
May 1	" 6	Sept. 3	" 11		

* The gestation period of cattle is from 270 to 290 days. The table is figured on 282 days.

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