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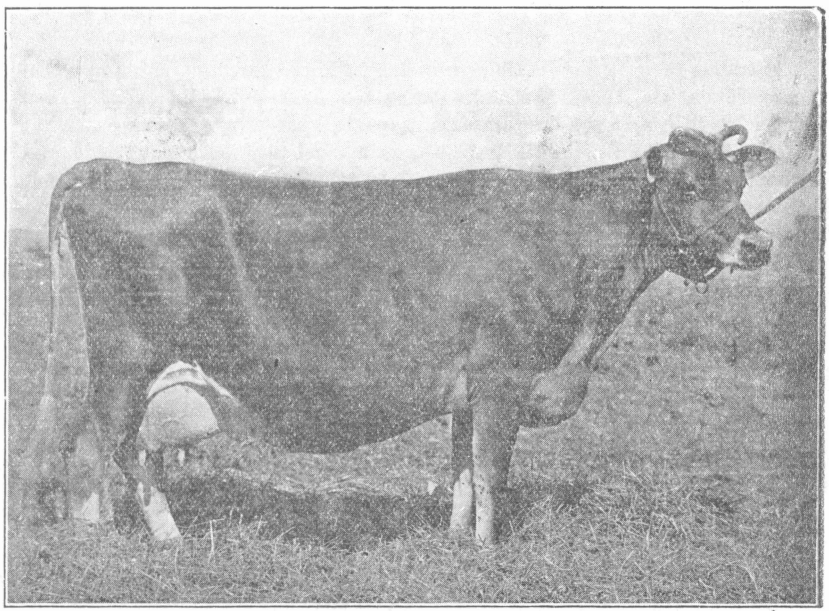
Feeding the Dairy Cow



COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS

(The Agricultural and Mechanical College of Texas and the United States Department of Agriculture Cooperating)

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Feeding the Dairy Cow

Since the coming of the white man, Texas has been a section where the growing of beef cattle is one of the leading industries. As the ranges are being cut up into small tracts for farming purposes, and the towns and cities growing larger and more numerous, the dairy cow is rapidly replacing the beef animal. The last decade has seen considerable change in this respect, especially in the sections close to the consuming centers where the demand for dairy products is constantly on the increase. The dairymen who are supplying the cities with market milk have, during this last decade, been confronted with many new problems in milk production. They have seen their free range cut up into farms, and all feeds which they have been obliged to purchase have doubled and tripled in price.

Studies of milk production problems in Texas during the last several years reveal the fact that many dairymen have not been able to keep pace with the rapidly changing conditions and are now producing milk at a positive loss. By depending on the market for both roughage and concentrates, they have found roughage to be so high in price that it has been used sparingly and heavy grain rations fed to furnish the required nutrition. However, since the cow is an animal that requires a liberal amount of rough and bulky feed, the results of this kind of feeding have not been satisfactory and the milk production has generally been exceedingly low and the cost per unit of production high.

ROUGHAGE

(The basis of Profitable Dairying is Cheap Roughage.)

The dairy cow is so constituted that to give the best results she naturally requires large amounts of bulky feed such as good pasture grass, silage and hay. These feeds, when produced on the farm where they are fed, are relatively cheap and should always form as large a part as possible of the ration for the dairy cow.

These feeds, however, if purchased on the market are necessarily high in price owing to the difficulty with which they are stored and shipped. To have sufficient roughage at a reasonable cost it is therefore necessary that the dairyman raise the same himself.

All dairymen know that the largest flow of milk is secured when the cows are on good pastures of grass that is sufficiently mature to contain large amounts of food nutrients and not be too laxative. The ideal pasture condition can be had only a few weeks during the year. The average pasture should therefore be supplemented with other feeds to approach as nearly as possible the ideal pasture conditions. In the

Spring when pastures are green and watery, cows should receive in addition to the grass, all the dry roughage they will consume. In the latter part of the summer, when the pastures are dry and inadequate, they should receive a liberal ration of silage or some soiling crops and in addition, what dry roughage they will consume.

The aim should always be to keep the roughage part of the ration just as near as possible to that of good pasture conditions. This can only be accomplished by having available at all times silage or soiling crops and hay of good quality.

PASTURES:

In many sections of the state, the natural grass pastures are scant or made up of grasses that are either not palatable or nutritious, the latter conditions being found throughout the great portion of the Gulf Coast country. Dairymen who have pastures of this character will do well to both improve the pastures by the addition of other grasses and supplement them with crops that can be grazed. For improving permanent pastures, Bermuda grass, carpet grass, lespedeza and bur clover are the most satsifactory. For crops grown especially for grazing, Sudan grass, Rhodes grass, sweet clover, cowpeas and velvet beans are good for summer pastures, while oats, wheat and barley are extensively used for winter and early spring pastures. Every dairyman should secure and study Farmers' Bulletin No. 1125, "Forage Crops for the Cotton Belt," and Farmers' Bulletin No. 1126, "Sudan Grass." These bulletins can both be secured from the United States Department of Agriculture, Washington, D. C.

HAYS:

As a general rule it is found that Texas dairymen pay too little attention to the raising and storing of sufficient hay to supply their animals with abundant roughage throughout the year. It should be the aim of every dairy farmer to produce sufficient hay to feed his herd liberally at all seasons of the year. If possible at least a half of this hay should be from legumes some of which can be grown on nearly every farm in the State, the more common ones being alfalfa, cowpeas, soy beans, velvet beans, Spanish peanuts and sweet clover. Sudan grass and cane are the leading grass hays. In some of the extremely southern counties of the state, Rhodes grass is being extensively used both for hay and pasture. Grasses and legumes can be mixed and grown together forming an excellent quality.

VALUE OF LEGUMES:

Under the heading of "Hays," legumes have been mentioned, but the writer wishes to call attention to the value of these forages for hay, and

NOTE:—The term ration means all the feed fed in one day, or 24 hours, and is generally divided into two feeds. The term concentrates and grain feeds are used interchangeably and are considered to mean grains, mill feeds, by-products and mixed feeds.

to the fact that most farms in Texas do not raise and store them for hays. Legumes are very necessary in the cow's ration, if dairy products are to be produced most economically. Texas dairymen are more and more coming in competition with dairy farmers of those sections that produce a large tonnage of alfalfa and sweet clover, and to meet that competition, we must grow and feed some of the legumes more abundantly than we are now doing. Legumes cheapen the ration because they are rich in protein and furnish in the roughage a large part of the protein portion of the ration which we are now furnishing to our animals by purchasing mill feeds and by-products.

When legume hays are used the concentrate allowance per pound of milk can be reduced much below the ratio required where hulls and fodder, and coarse grass hays form the roughage. Legumes are rich in minerals and furnish sufficient mineral for the average cow, while the grass hays and most concentrates are deficient in mineral matter to the extent that many of our best feeders are supplying minerals to their animals by adding bone meal and ground limestone to the concentrate mixture.

Some legume plant can be grown on practically every farm in Texas. Sweet clover is fast growing in popularity. Where it has been tried, it has proved very profitable as a pasture crop and it also makes good hay. On sandy lands the cowpea will always be found to be a valuable hay crop.

SILAGE:

Even with abundant hay of good quality and large variety, cows will be found to do better if supplied with a supplementary ration of succulent feed. Outside of good pastures this is most easily and cheaply supplied in the form of silage. Many dairymen who have been in business with and without silage, are frank to say that they would not attempt to operate a dairy unless they could have silage available when needed. The crops commonly used for silage are corn, sorghum, kafir, milo and feterita and in some sections of the state, seeded ribbon cane. In most sections of the state some of the grain sorghums are used, owing to the fact they produce a heavier tonnage than corn.

CONCENTRATES:

The dairy cow that produces a large flow of milk is an animal that is doing work in just as true a sense as is the horse that is pulling the plow. Although the dairy cow has a capacity for large amounts of rough feed, she cannot consume sufficient of such feed to supply the necessary nutrients to do the work of producing milk in large quantities and at the same time maintain normal body weight; therefore, if maximum milk production is to be reached and maintained, she must be fed with a grain ration which will supply the deficiencies in the roughage.

The question of "how much concentrates to feed a cow" is one of great economic importance to the dairyman.

If, as pointed out above, the roughage is of good quality a large part of it being legumes, good production can be maintained on a comparatively light concentrate ration—1 lb. of concentrates to 3 or 3¼ lbs. of milk—but if the roughage is of inferior quality, such as prairie hay and cotton seed hulls, the dairyman must make up the deficiency by feeding a heavy concentrate ration—1 lb. of concentrates to 2 or 2½ lbs. of milk production.

Since it requires about half of all the feed the average cow will consume to maintain her body it is poor economy to under-feed and it should be the aim of every dairyman to supply the cow with just as much feed above a maintenance ration as she will consume economically. It therefore becomes necessary to know the production of each cow and feed her according to her ability to convert feed into milk. Some cows are responsive to heavy feeding; others have naturally little ability to produce milk and will produce as much on a light grain ration as on a heavy one. On such cows, heavy grain feeding would mean a corresponding loss while with the responsive cow, heavy grain feeding will produce good returns.

If cows are in good flesh, and in good physical condition at time of calving, they should soon thereafter produce a normal flow of milk which will indicate very closely their productive ability. The dairyman should take this as his guide and feed to maintain this milk flow. It is a fact without question, that the cow recently fresh and producing 30 lbs. of milk per day, requires much more feed nutrients than does a cow of equal weight producing only 10 lbs. of milk per day. Yet it is often found that all cows in a herd are fed equal amounts of concentrated ration. By this system of feeding the fresh cow rapidly loses in weight and also falls off rapidly in milk production and in a few weeks is producing little or no more than the average of the herd.

FEED REQUIREMENTS:

The average cow of 1000 lbs. live weight requires approximately .7 lbs. crude protein, 7.0 lbs. carbohydrates, 0.1 lbs. of fat per day to maintain her body. In addition, she requires approximately .06 lbs. of crude protein, 0.26 lbs. of carbohydrates and 0.23 lbs. of fat per day for every pound of 4½ per cent milk she produces. The cow therefore, that weighs 1000 lbs. and produces 30 lbs. of 4½ per cent milk per day, requires:

For maintenance ..... .7 lbs. protein, 7.0 lbs. carbohydrates, .1 lbs. fat
For 30 lbs. 4½% milk....1.8 lbs. protein, 7.8 lbs. carbohydrates, .69 lbs. fat

Total requirement .....2.5 lbs. protein, 14.8 lbs. carbohydrates, .79 lbs. fat

If she were producing 20 lbs. of 4½ per cent milk per day, she would require:

For maintenance ..... .7 lbs. protein, 7.0 lbs. carbohydrates, .1 lbs. fat

For 20 lbs. 4½% milk....1.2 lbs. protein, 5.2 lbs carbohydrates, .46 lbs. fat

Total requirements .....1.9 lbs. protein, 12.2 lbs. carbohydrates, .56 lbs. fat

If she were producing only 10 lbs. of 4½ per cent milk per day, the rements would be as follows:

For maintenance ..... .7 lbs. protein, 7.0 lbs. carbohydrates, .1 lbs. fat

For 10 lbs. 4½% milk.... .6 lbs. protein, 2.6 lbs. carbohydrates, .23 lbs. fat

Total requirements .....1.3 lbs. protein, 9.6 lbs. carbohydrates, .33 lbs. fat

To determine the amount of various feeds to use in a ration, it is necessary to use a table which gives the digestible nutrients of the feeds to be used.

The following table gives the digestible nutrients of some of the common feeds:

PER CENT DIGESTIBLE NUTRIENTS IN ROUGHAGE

Feed	Protein	Carbohydrates	Fat
Corn stover	2.1	42.4	0.7
Corn shucks	6.6	47.3	0.3
Grain sorghum fodder	4.1	45.0	1.7
Sudan or Johnson grass hay	2.9	45.0	1.0
Prairie hay	4.0	41.4	1.1
Oat hay	4.5	38.1	1.7
Alfalfa hay	11.2	42.0	0.7
Cowpea hay	13.1	33.7	1.0
Peanuts with hulls	9.6	39.6	9.3
Peanut hay	6.6	37.0	3.0
Wheat straw	0.7	35.1	0.5
Sorghum hay	2.8	44.8	2.0
Cactus	0.4	8.9	0.2
Sorghum silage	0.6	11.6	0.5
Bermuda	3.7	37.9	0.8
C. S. Hulls	0.3	33.3	1.5

PER CENT OF DIGESTIBLE NUTRIENTS IN CONCENTRATES

Feed	Protein	Carbohydrates	Fat
Cottonseed Meal	37.0	21.8	8.6
Cocoanut meal	18.8	42.0	8.1
Wheat bran	12.5	41.6	3.0
Velvet bean seed with pod	14.9	51.7	3.8
Rice bran	7.9	38.1	8.8
Peanut meal	32.4	19.23	5.4
Corn bran	5.8	56.9	4.6
Corn chops	6.9	69.0	3.5
Grain sorghum	9.0	65.0	2.3
Grain sorghum with heads	6.1	56.6	2.0
Oats	9.7	52.1	3.8
Hominy feed	6.3	64.1	5.6
Molasses feed	7.4	47.7	4.2
Wheat shorts	13.4	46.2	4.3
Corn and cob meal	6.1	63.7	3.7
Cottonseed	13.3	29.6	16.5

HOW TO CALCULATE BALANCED RATIONS

A ration for a 1000 lb. cow producing 20 lbs. of 4½% milk per day:

By referring to the table showing the requirements for a 1000 lb. cow producing 20 lbs. of 4½% milk per day, it will be found that she requires 1.9 lbs. protein, 12.2 lbs. carbohydrates, and .56 lbs. of fat.

The feed nutrients in the available roughage for the ration is first determined. If sorghum silage, cowpea hay and Sudan grass are available and the cow is fed 30 lbs. of the silage, 5 lbs. of the cowpea hay and 5 lbs. of Sudan grass hay, the feed nutrients in the roughage would be found to be according to the following table:

Feed	Protein	Carbohydrates	Fat
30 lbs. sorghum silage	.18	3.5	.15
5 lbs. cowpea hay	.65	1.68	.05
5 lbs. Sudan grass hay	.15	2.25	.05
Total ingredients in roughage ration	.98	7.43	.25

These nutrients it will be noted, are considerably less than the requirements of the cow. Concentrates, therefore, must be added to make up the deficiency. The next step is to determine the feed nutrients in one pound of the concentrate mixture to be used. If a mixture in the proportion of 1 lb. of cottonseed meal, 5 lbs. sorghum grains, and 2 lbs. of wheat bran is to be used, by referring to the table of concentrate contents the food nutrients will be found to be according to the following table:

Feed	Protein	Carbohydrates	Fat
1 lb. cottonseed meal	.37	.22	.08
5 lbs. sorghum grains	.45	3.20	.11
2 lbs. wheat bran	.25	.84	.06
Total	1.07	4.26	.25

There is a total of 8 lbs. of concentrates in the mixture, one pound therefore, will contain ⅛ of the total feed nutrients or .135 lbs. protein, .532 lbs. carbohydrates, and .03 lbs. fat. If the cow under consideration giving 20 lbs. of milk per day, is fed 1 lb. of grain mixture for each 2½ lbs. of milk production, she will receive 8 lbs. of grain. The feed nutrients contained in 1 lb. of grain mixture should then be multiplied by 8, the number of pounds to be fed, and the result added to the feed nutrients furnished by the roughage. The sum then, is the total feed nutrients to be given the cow.

Feed	Protein	Carbohydrates	Fat
Nutrients in roughages	.98	7.43	.25
Nutrients in 8 lbs. c oncentrates	1.07	4.26	.25
Total	2.05	11.69	.50

By referring to the table of requirements for a 1000 lb. cow giving 20 lbs. of 4½% milk, it will be found that this ration furnishes approximately the nutrients required.

If the cow is producing only 10 lbs. of 4½% milk it will be found by referring to the table giving the requirements for a 1000 lb. cow producing 10 lbs. of 4½% milk, that 1.3 lbs. protein, 9.6 lbs. carbohydrates and .33 lbs. of fat, is required. If the same ration of roughage is furnished the cow as when producing 20 lbs. of milk, and the same grain mixture is fed in the proportion of one lb. for each 2½ lbs. of milk production, she will receive only 4 lbs. of the grain mixture. The total feed nutrients furnished will be found as per the following table:

Feed	Protein	Carbohydrates	Fat
Feed nutrients in the roughage	.98	7.43	.25
Feed nutrients 4 lbs. grain mixture	.54	2.13	.12
Total	1.52	9.56	.37

By referring to the requirements for a 1000 lb. cow producing 10 lbs. of milk per day, it will be found that this ration meets very closely the requirements

Calculations similar to the above can be made for cows giving any amount of milk. Dairymen should first calculate the nutrients in the rations they are using, and then correct them if necessry to more closely meet the needs of the cow.

It will be noted that in forming the above rations, the amount of roughage was considered to be the same for the cow when producing different amounts of milk. It has been found that if a cow is furnished all the roughage she will consume, she will take about 2 lbs. of dry roughage or 1 lb. of dry roughage and 3 lbs. of silage per day for each 100 lbs. of live weight. However, in case of extremely high producers, where a very heavy grain ration is necessary, there is a tendency to consume slightly less of the roughage.

A change in the ration of any one feed will generally necessitate changes in some others, for example, if in the ration given above, the cowpea hay was not available and Sudan grass hay was used, the protein content of the ration would be considerably reduced and the carbohydrates increased. This, then, should be corrected in the grain ration by increasing the cottonseed meal which is rich in protein and decreasing the amount of grain sorghum which is very high in carbohydrates, thus again establishing a balance which is lost when the Sudan hay is substituted for the cowpea hay.

The above rations have all been calculated with the idea of maintaining maximum production. The market on which dairy products are sold will determine to a large extent the economy of feeding for maximum production. Where the product from the dairy is sold as market milk, at $4.00 to $4.50 per cwt., it is economy to increase the grain ration 1 lb. for each 2½ lbs. of increase in production that can be secured and maintained. The grain ration, however, should be correspondingly decreased when a cow begins to decrease in milk flow.

Comparatively few farmers are so located that they can market the whole milk, but must dispose of the product in the form of cream or butterfat. In such cases, it is not generally good economy to feed heavy grain rations except to cows of large producing ability. Cows of average ability will yield larger net returns when fed largely on good quality of roughage than if fed heavily on grains. It will be found to be good economy to feed just as liberal a grain ration as is possible to do without decreasing the net returns. Cows thus fed even a light grain ration, will not react as quickly to adverse conditions as those that are fed entirely on roughage; for this reason, it will generally be found to be poor economy not to feed any grain at all.

WATER:

Since a cow consumes such large quantities of rough feed, much of it being in a dry state, she requires much water that it may be properly digested. In addition, the cow is continually producing large quantities of milk, which is about 87 per cent water, which makes an added requirement. The cow, therefore, should have available pure water, that she may drink as often and as much as she desires.

SALT:

Salt should be furnished the dairy cow at the rate of about 1 ounce per day in her grain ration, or better, placed in boxes provided for that purpose where she can eat it at will.

HULLS AND MEAL AS A RATION FOR DAIRY COWS:

Some dairymen cannot seem to break away from the idea of hulls and meal as a ration for a dairy cow. This ration cannot be made to furnish the necessary feed nutrients except for a cow of very low producing ability, for example a cow weighing 1000 lbs., and producing 10 lbs. of 4½ per cent milk, requires 1.3 lbs. of protein, 9.6 lbs. carbohydrates and .33 lbs. fat. Hulls and meal alone will furnish the nutrients for this ration in almost correct proportions:

Feed	Protein	Carbohydrates	Fat
27 lbs. hulls	.08	8.99	.4
3 1-2 lbs. cottonsed meal	1.36	.76	.4
Total	1.44	9.75	.8

It will be noted, however, that there is no variety in such a ration and that the amount of cottonseed hulls is greater than the roughage the average cow will consume. A ration of this character, therefore, cannot be considered where any large production is the object to be attained.

FEEDING A DAIRY COW PREVIOUS TO CALVING

Experience has proved that for a maximum annual production a cow should be dry from 6 to 8 weeks before calving, during which time she should be liberally fed on good roughage, in pasture if possible, and

grain feeds that are not heat-producing, such as bran and oats. Corn may be used very sparingly as a fat producer that she may be in good flesh at time of calving. A cow should be in good flesh at this time that she may have a reserve supply of material in her body from which to take milk during the few first days after calving, at which time she is in a feverish and more or less weakened condition and should receive little grain except a cooling and laxative feed such as bran. As soon as the feverish condition has passed the regular grain ration should be used, 4 to 5 lbs. per day at first and gradually increased until 1 lb. of the grain mixture is fed for every 2½ lbs. to 3 lbs. of milk produced. While the cow is gaining in milk flow, the grain ration should be increased in proportion. When the maximum milk flow is reached, it should be kept as near constant for as long a time as possible but as the period of lactation advances, there will be a decrease in production and there should be a corresponding decrease in the grain ration fed.

HOW TO FEED A DAIRY CALF

The farmer will have to increase the number and quality of dairy cows that are being kept on Texas farms in order to meet economically the growing demand for dairy products. This may be best accomplished by breeding the cows to the highest type of pure bred dairy bulls possible, saving the heifer calves and cows to replace the worn out and non-profitable dairy cows. In this manner a dairyman can start with common cows and build up a high producing herd within a few years. The dairyman who replenishes his herd by purchase must pay high prices for animals which may not be well bred, although of good appearance, and they may prove to be poor producers. Furthermore, it is much easier to keep the herd free from such diseases as tuberculosis and contagious abortion when the heifers are home raised than it is when they are continually being brought in from outside sources.

The value of the calf at birth depends primarily on its breeding; however, the feed and care which it receives while young are equally as important factors in deciding its future usefulness in the herd. In our work with the dairy farmers of the state, we find no phase of the dairy work more generally neglected and perhaps less understood than that of properly feeding and caring for the calves when they are taken from the cows and placed on a ration of skim milk and grain feed. As a result of this neglect a large per cent of the dairymen of the state lose a great many of their calves during the first few weeks after birth. Other dairymen who take certain precautions in feeding and caring for their calves are raising them without loss or even detrimental effects from scours, etc.

Milk is the ideal feed for young calves, but it is too costly. They can be reared as well on skim milk and grain feed, which furnishes the fat in much cheaper form. Skim milk differs from whole milk only in having had most of the fat removed. Owing to the removal of the fat, skim milk is a much more nitrogeneous feed than whole milk, having a nutritive

ratio of 1:1.5 as compared with 1:4.4 for unskimmed milk. Failing to appreciate this fact, some dairymen are supplementing skim milk with nitrogeneous concentrates, such as linseed meal, cottonseed meal and wheat bran. It is evident, however, that in skim milk supplement the need is not for additional protein, but for an abundance of energy-giving carbohydrates or fat to replace the fat that has been removed from the milk.

The young calf should be allowed to get its milk from the dam for two or three days. Many dairymen never allow the calf to draw milk from the mother, claiming that if separated at once the calf learns more readily to drink from a pail. Nevertheless, the calf should always get the first milk (colostrum) which is destined by nature for cleansing the bowels and starting the digestive functions. If the cow is a heavy milker, the calf should not be allowed to gorge the milk as it will result in indigestion and scours. The young calf has a small stomach and naturally takes milk frequently and in small quantities.

When the milk feeding begins small calves should be given six pounds a day of their mother's milk for the first day or two, divided between two feedings. Larger calves should be given more determined according to their size and vigor. In all cases the milk should be fed as fresh as possible and at blood heat, the temperature being determined by a thermometer, which most careful feeders use. The amount of milk given should be gradually increased, although we should avoid overfeeding the small calf at all times, as it is often the cause of scours and poor success in calf raising.

When the calf is from two to four weeks old (the exact age depending on its vitality) skim milk may gradually replace the whole milk. Substitute one-half pound of skim milk at each feeding until the change has been completely made, taking a week or ten days to make the change. The skim milk may be increased as follows for the average calf: Four pounds at a feed when five weeks of age; five pounds at seven weeks; six pounds at nine weeks; seven pounds at ten weeks; and eight pounds at twelve weeks. The feed should not exceed nine or ten pounds at a feed during the skim milk period, which often lasts from six to eight months.

At feeding time hand-reared calves should be confined in stanchions for a short time after the milk is drunk until they consume their grain feed and overcome the desire to suck each other's ears and udders. Calves may alse be fed much easier and more satisfactorily when confined in stanchions than when allowed to run loose. The stanchions can be made easily. When this precaution is neglected the shape of the udder may be injured and the heifer may persist in sucking herself or others.

When calves are about two weeks old they should be taught to eat some grain feed, such as a mixture of two pounds of corn or maize chops and one pound of wheat bran. At six weeks of age a calf will usually eat one-half pound of this mixture a day; at two months of age about one

pound a day; at three months of age about two pounds a day. Gradually increase until the calf is receiving three pounds a day at six months of age. In addition to this it should have all the clean hay, such as clover or alfalfa that it will eat up clean. Calves will begin to eat hay at about the same age as they do grain and they consume about the same quantity of each at first, but as the calf grows and its paunch or stomach develops, the proportion of roughage to concentrates should be increased until six months of age, at which time it will be consuming about three times as much hay as grain.

Calves should be supplied with an abundance of pure fresh water at all times. This is often neglected, but should be attended to as calves from two to three months of age consume an average of about ten pounds of water daily. As soon as the calf begins to eat grain and hay it should be given salt the same as other animals.

When a calf is dropped in the barn or in the cow lot the naval of the calf should be washed with an antiseptic solution and tied with a silk thread immediately after birth, in order to prevent naval infection. Should the calf be dropped in pasture or on a clean place this precaution is not necessary.

The thrifty calf should gain from 1½ pounds to 2 pounds a day for the first four to six months when properly fed on skim milk along with suitable grain and roughage in a liberal supply. Do not endeavor to fatten the calf, but keep it in a vigorous growing condition, building strong bone and muscle. When skim milk calves do not do well it is generally because of improper feeding, such as lack of sunlight and fresh air, feeding at irregular intervals, feeding cold or stale milk, feeding from pails that have not been scalded daily, feeding improper concentrates, or allowing the excess to ferment and stale in the feed box.

There are a number of calf meals and substitutes for skim milk which are used with a fair degree of success, where whole milk is sold and no skim milk is available, but a lack of space prevents a discussion of these substitutes.

FEEDS AND RATIONS

The following rations will be suitable for cows of average producing ability only. For high production of 25 pounds of milk per day and above, special rations should be made to fit the requirements of the individual case.

Ration No. 1

Low Protein Roughages:—When such roughages are fed, as Johnson grass, Sudan grass hay, Bermuda grass and cane hay, and fodders, a grain mixture can be made that will practically make a balanced ration by using:

Cottonseed Meal ..... 150 lbs.
Wheat bran ..... 100 lbs.
Corn, or grain sorghum or barley..... 100 lbs.
Ground oats ..... 100 lbs.

This mixture can be fed at the rate of one pound to each 2¼ to 2½ lbs. of milk production.

Ration No. 2

If a part of the roughage is one of the grass hays or fodders as in Ration No. 1, and a part cottonseed hulls, the same grain mixture can be used as in Ration No. 1, but will have to be fed at the rate of 1 lb. to each 2 lbs. of milk produced, to maintain the production because of the low feed value of the hulls in the ration.

Ration No. 3

Medium Protein Roughage:—When half of the roughage is of grass hays or fodder, as in Ration No. 1, and the other half a legume hay, a grain mixture lower in protein will be found suitable and can be made up of the following mixture:

Cottonseed meal ..... 50 lbs.
Wheat bran ..... 100 lbs.
Corn or grain sorghum or barley..... 200 lbs.

With this better class of roughage, the grain can be fed at the rate of 1 lb. for each 2½ to 2¾ lbs. of milk production.

Ration No. 4

High Protein Roughage:—When all the roughage is a legume hay such as cowpeas, sweet clover, or alfalfa a grain mixture comparatively low in protein can be used and can be made up of:

Cottonsed meal ..... 50 lbs.
Wheat bran ..... 50 lbs.
Corn or grain sorghum or barley..... 250 lbs.

The mixture fed at the rate of 1 lb. for each 3 lbs. of milk production. The above feeds are calculated for use when the feeding is to be done in a dry lot, but better results can be had when the animals are on pasture. If the animals get a part of their roughage in the form of grass in addition to the dry roughage as in Rations No. 1 and 2, a grain mixture of equal parts can be used.

Cottonseed meal ..... 100 lbs.
Corn or grain sorghum or barley..... 100 lbs.
Wheat bran ..... 100 lbs.
Ground oats ..... 100 lbs.

If the dry roughage is largely legume in nature, a greater percentage of corn can be used in the ration and a mixture can be made of:

Cottonseed meal	100 lbs.
Wheat bran	100 lbs.
Corn or grain sorghum or barley	200 lbs.
Ground oats	200 lbs.

When animals are on good pasture and are also getting hay, it should not be necessary to feed more than 1 lb. of the grain mixture to each 3 to 3½ lbs. of milk to maintain the production.

In all these rations there is corn, and it should be remembered by the feeder that corn feeds, grain sorghum grains, and barley are similar feeds and can be interchanged, thus allowing the feeder to use the largest possible amount of home grown feeds.

It should always be kept in mind by the feeder that low protein roughages require high protein concentrates to balance, but that comparatively low protein concentrates can be used when legumes make up the greater part of the roughage. Grass pasture requires medium mixture of grain.

By raising plenty of legume hay, planting grasses for pasturage and raising corn and grain sorghums, the dairy herd can be largely fed on feeds that are produced on the farm.

It is generally found profitable to add a mineral mixture consisting of steamed bone meal and ground limestone at the rate of about two lbs. to each 100 lbs. of feed mixtures, except where the cows are getting a large percent of legume hay.